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OECD Environmental Performance Reviews: Denmark 2019



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Foreword

The principal aim of the OECD Environmental Performance Review programme is to help member and selected partner countries improve their individual and collective performance in environmental management by:

- helping individual governments assess progress in achieving their environmental goals
- promoting continuous policy dialogue and peer learning
- stimulating greater accountability from governments towards each other and public opinion.

This report reviews the environmental performance of Denmark since the previous review in 2007. Progress in achieving domestic objectives and international commitments provides the basis for assessing the country's environmental performance. Such objectives and commitments may be broad aims, qualitative goals or quantitative targets. A distinction is made between intentions, actions and results. Assessment of environmental performance is also placed within the context of Denmark's historical environmental record, present state of the environment, physical endowment in natural resources, economic conditions and demographic trends.

The OECD is indebted to the government of Denmark for its co-operation in providing information, for the organisation of the review mission to Copenhagen (26-29 November 2018) and for facilitating contacts both inside and outside government institutions.

Thanks are also due to the representatives of the two examining countries, Andrew McNee (Australia) and Arthur ten Wolde (Netherlands).

The authors of this report were Rafal Brykowski, Nathalie Cliquot, Britta Labuhn and Simon Apelblat Thomsen from the OECD Secretariat. Nathalie Girouard and Gérard Bonnis provided oversight and guidance. Carla Bertuzzi provided statistical support, Annette Hardcastle provided administrative support and Rebecca Brite copy-edited the report. Natasha Cline-Thomas provided communications support. Preparation of this report also benefited from inputs and comments from several members of the OECD Secretariat, including Aad van Bohemen, Nils Axel Braathen, Ivana Capozza, Nathalie Delrue, Kathleen Dominique, Mikkel Hermansen, Katia Karousakis, Hannah Leckie, Xavier Leflaive, Eeva Leinala, Eugene Mazur, Will Symes, Özlem Taskin and Jonas Teusch.

The OECD Working Party on Environmental Performance discussed the draft Environmental Performance Review of Denmark at its meeting on 25 April 2019 in Paris and approved the Assessment and recommendations.

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Reader's guide

Signs

The following signs are used in figures and tables:

.. : not available

– : nil or negligible

. : decimal point

Country aggregates

OECD Europe: This zone includes all European member countries of the OECD, i.e. Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

OECD: This zone includes all member countries of the OECD, i.e. the countries of OECD Europe plus Australia, Canada, Chile, Israel*, Japan, Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.

Currency

Monetary unit: Danish krone (DKK)

In Q1 2019, USD 1 = DKK 6.572; EUR 1 = DKK 7.464

In 2018, USD 1 = DKK 6.315; EUR 1 = DKK 7.453

In 2017, USD 1 = DKK 6.603; EUR 1 = DKK 7.439

In 2016, USD 1 = DKK 6.732; EUR 1 = DKK 7.445

Cut-off date

This report is based on information and data available up to early April 2019.

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* The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

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Abbreviations and acronyms

ADS	AffaldsDataSystemet (Danish waste data system)
AMAP	Arctic Monitoring and Assessment Programme
C&D	Construction and demolition
CAP	Common Agricultural Policy
CCS	Carbon capture and storage
CEHOS	Danish Centre on Endocrine Disrupters
CHP	Combined heat and power
CIS	Danish Chemical Inspection Service
CLP	Classification, Labelling and Packaging Regulation
CLRTAP	Convention on Long-range Transboundary Air Pollution
CO_2	Carbon dioxide
DMC	Domestic material consumption
DPA	Danish Producer Responsibility System
EAP	Environmental Action Programme
ECHA	European Chemicals Agency
EDC	Endocrine-disrupting chemical
EGS	Environmental goods and services
EIA	Environmental impact assessment
EKF	Danish Export Credit Agency
ELV	End-of-life vehicle
EMEP	European Monitoring and Evaluation Programme
e-MARS	Major Accident Reporting System
EPA	Danish Environmental Protection Agency
ETS	Emissions Trading System
EUDP	Energy Technology Development and Demonstration Programme
EV	Electric vehicle
GDP	Gross domestic product
GEP	Good Experimental Practice
GHG	Greenhouse gas
GHS	Globally Harmonized System
GLP	Good Laboratory Practice
HELCOM	Helsinki Commission (Convention on Protection of the Marine Environment of the Baltic Sea Area)
IFU	Investment Fund for Developing Countries
IUCN	International Union for Conservation of Nature
LOUS	Danish List of Undesirable Substances
LULUCF	Land use, land-use change and forestry
MA	Maritime Authority
MARPOL	International Convention for the Prevention of Pollution from Ships
MEA	Multilateral environmental agreement
MEF	Ministry of Environment and Food
MCEU	Ministry of Climate, Energy and Utilities
MIBFA	Ministry of Business, Industry and Financial Affairs
MLRF	Multifunctional Land Redistribution Fund
NEC	National Emission Ceilings

NGO	Non-government organisation
NH_3	Ammonia
NMVOC	Non-methane volatile organic compound
NOVANA	National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environment
NO_X	Nitrogen oxide
ODA	Official development assistance
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PFAS	Per- and polyfluoroalkyl substances
PISA	Programme for International Student Assessment
PLI	Pesticide load indicator
$PM_{2.5}$	Fine particulate matter
POP	Persistent organic pollutant
PPP	Purchasing power parity
PRO	Producer responsibility organisation
PRTR	Pollutant release and transfer register
PSO	Public Service Obligation
PVC	Polyvinyl chloride
(Q)SAR	(Quantitative) Structure-Activity Relationship
R&D	Research and development
RBMP	River Basin Management Plan
RD&D	Research, development and demonstration
RDP	Rural Development Programme
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation
RIA	Regulatory impact assessment
SAICM	Strategic Approach to International Chemicals Management
SDG	Sustainable Development Goal
SEA	Strategic environmental assessment
SMEs	Small and medium-sized enterprises
SO_2	Sulphur dioxide
TBT	Tributyltin
TPES	Total primary energy supply
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VFA	Veterinary and Food Administration
WEA	Working Environment Authority
WEEE	Waste electrical and electronic equipment

Basic statistics of Denmark

2018 or latest available year (OECD values in parentheses)[a]

PEOPLE AND SOCIETY					
Population (million)	6		Population density per km²	134	(36)
Share of population by type of region:			Population compound annual growth rate, latest 5 years	0.4	(0.6)
Predominantly urban (%)	23	(48)	Income inequality (Gini coefficient)	0.26	(0.32)
Intermediate (%)	49	(27)	Poverty rate (% of pop. with less than 50% median income)	5	(11)
Rural (%)	29	(25)	Life expectancy	81	(81)
ECONOMY AND EXTERNAL ACCOUNTS					
Total GDP (National currency, billion)	2.2		Imports of goods and services (% of GDP)	49	29
Total GDP (USD, billion, current prices and PPPs)	326		Main exports (% of total merchandise exports)		
GDP compound annual real growth rate, latest 5 years	2.0	(2.3)	Machinery and transport equipment	28	
GDP per capita (1 000 USD current PPPs)	57	(46)	Chemicals and related products	23	
Value added shares (%)			Food and live animals	16	
Agriculture	1	(2)	Main imports (% of total merchandise imports)		
Industry including construction	23	(25)	Machinery and transport equipment	34	
Services	76	(73)	Miscellaneous manufactured articles	16	
Exports of goods and services (% of GDP)	55	(29)	Manufactured goods	14	
GENERAL GOVERNMENT Percentage of GDP					
Expenditure	51.2	(40.6)	Education expenditure	6.5	(5.2)
Revenue	52.3	(37.8)	Health expenditure	8.4	(7.6)
Gross financial debt	48.9	(112.5)	Environment protection expenditure	0.4	(0.5)
Fiscal balance	1.2	-(2.8)	Environmental taxes: (% of GDP)	4.0	(1.6)
			(% of total tax revenue)	8.7	(5.3)
LABOUR MARKET, SKILLS AND INNOVATION					
Unemployment rate (% of civilian labour force)	5.7	(5.8)	Patent applications in environment-related technologies (% of all technologies, average of latest 3 years [b]	18	(10)
Tertiary educational attainment of 25-64 year-olds (%)	39	(37)	Environmental management	5	(4)
Gross expenditure on R&D, % of GDP	3.1	(2.4)	Water-related adaptation technologies	0.4	(0.5)
			Climate change mitigation technologies	15	(7)
ENVIRONMENT					
Energy intensity: TPES per capita (toe/cap.)	3.0	(4.1)	Road vehicle stock (vehicles./100 inhabitants)	54	(64)
TPES per GDP (toe/1 000 USD, 2010 PPPs)	0.06	(0.11)	Water stress (abstraction as % of available resources)	4.0	(9.7)
Renewables (% of TPES)	35	(10)	Water abstraction per capita (m³/cap./year)	115	(804)
Carbon intensity (energy-related CO_2):			Municipal waste per capita, (kg/capita)	785	(524)
Emissions per capita (t/cap.)	5.9	(9.0)	Material productivity (USD, 2010 PPPs/DMC, kg)	2.0	(2.4)
Emissions per GDP (t/1 000 USD, 2010 PPPs)	0.13	(0.24)	Land area (1 000 km²)	42	
GHG intensity: [c]			% of arable land and permanent crops	57	(12)
Emissions per capita (t CO_2 eq/cap.)	9.0	(12.0)	% of permanent meadows and pastures	5	(22)
Emissions per GDP (t CO_2 eq/1 000 USD, 2010 PPPs)	0.20	(0.31)	% of forest area	15	(31)
Mean population exposure to air pollution ($PM_{2.5}$), µg/m³	10.4	(12.5)	% of other land (built-up and other land)	23	(34)

a) Values earlier than 2013 are not taken into consideration. OECD value: where the OECD aggregate is not provided in the source database, a simple OECD average of the latest available data is calculated where data exist for a significant number of countries.
b) Higher-value inventions that have sought protection in at least two jurisdictions.
c) Excluding emissions/removals from land use, land-use change and forestry.
Source: Calculations based on data extracted from databases of the OECD, IEA/OECD, EUROSTAT and the World Bank.

Executive summary

Maintain efforts to manage water pollution and preserve nature

Denmark outperforms the OECD average for most of the Sustainable Development Goals. It has decoupled its greenhouse gas (GHG) and major air pollutant emissions from economic activity. Denmark ranks among the OECD countries with the lowest energy intensity, thanks to a proactive energy efficiency policy. It has experienced a boom in renewable energy resources over the last decade, with renewables rising from 15% to 35% of total primary energy supply, driven by strong political will and public acceptability. Denmark has become a world leader in wind energy technology thanks to the significant and growing support of electricity consumers (via the electricity bill). It is now committed to increasing the share of renewables in gross final energy consumption from 30% in 2020 to 55% by 2030.

Despite progress, environmental challenges persist. In spite of strong nitrogen pollution management policies over the past decade, Denmark still faces excessive levels of nitrogen discharges into its coastal waters, of which only 1.7% are in good ecological status. Denmark's spatial planning policy promotes the interconnectivity of areas of interest for nature protection, but the nature protection policy does not set targets for protected areas other than biodiversity forests (which represent a very small part of Denmark's land).

Strengthen co-operation with municipalities to improve environmental governance

Denmark has a well-functioning environmental governance system at the central level. Particular assets include cross-party political agreements, proactive participation by civil society in policy making and high-quality advisory bodies. Socio-economic impact assessment of government decisions that may have an impact on the environment is used extensively, though not always systematically. Since 2007, Denmark's 98 municipalities have been responsible for increasing aspects of environmental management. However, environmental rules have not always been applied in comparable ways countrywide. The government has used task forces and sharing of expertise to build capacity in municipalities. Expanding these efforts to domains and regions where municipalities face challenges will be important going forward.

Farmland takes up more than 60% of the surface area, making the agriculture sector a key player in the protection of the environment. Spatial planning and land banking are part of the strategies used to manage environmental protection in agriculture. In particular, municipalities must designate existing and potential natural areas on the Green Map and take them into account when preparing land use plans. Efforts to convert environmentally valuable farmland into natural sites through the Multifunctional Land Redistribution Fund could be scaled up, including through the mobilisation of private funds.

Involve all sectors of the economy to move towards a carbon-free economy by 2050

Green growth is high on Denmark's political agenda. The country aspires to achieve 100% green electricity by 2030 and zero net GHG emissions by 2050. It is one of the first countries to develop and implement a green energy strategy based on a broad political

agreement. This Energy Agreement helps create a climate of trust for investors in clean energy and public acceptability to support the consumer prices of such energy. The 2018 Energy Agreement aims to further develop renewables and improve energy efficiency at market-like conditions. At the same time, energy tax concessions for businesses should be removed as they reduce incentives to save energy and reduce CO_2 emissions.

Achieving the 2050 goal will, however, require decarbonising sectors beyond energy, such as transport and agriculture. Tax concessions on the purchase and ownership of cars aim to increase the market share of energy-efficient cars and electric cars in the vehicular fleet. These concessions reduced environmentally related tax revenue to 3.7% of GDP, although that remains the highest level in the OECD. Decarbonising the agriculture sector involves identifying low-carbon farming practices, a path in which Denmark has engaged through research and development programmes. Pending transition to cleaner transport and development of mitigation measures for agriculture, Denmark is using flexibility mechanisms to achieve its ambitious goal of reducing GHG emissions outside the EU Emissions Trading System by 39% compared to 2005 levels by 2030.

Streamline municipal waste management to foster the circular economy

Denmark has long paved the way for circular economy approaches by promoting eco-design, clean production, eco-innovation and sustainable consumption. In 2018, a political agreement was reached on circular economy, with a strong focus on how business can become its engine and how government can help. Nevertheless, total waste generation rose by 30% between 2010 and 2016. Since 2007, Denmark has had the highest levels of municipal waste per capita in the OECD, with 785 kg per inhabitant in 2017. At the same time, the country has managed to nearly eliminate landfilling. It has also achieved impressive results in material recovery of most waste streams. Household waste remains a notable exception, however, with about half going to incineration with energy recovery.

Municipalities have considerable autonomy in waste management planning, including on the treatment of most waste. The cost of waste management services is among the highest in OECD Europe. Heavy investment by municipalities in incineration plants has created excess capacity. That, along with a lack of harmonised rules on waste sorting, limits incentives for investment in recycling and reuse.

Prioritise chemicals management policy based on risk to health and the environment

Denmark has put in place strong institutional and policy frameworks, as well as exemplary stakeholder co-operation, to manage the health and environmental risks associated with the use of chemicals. The shift from an *ad-valorem* tax on pesticides to an impact-based tax in 2013 reduced by 40% the health, ecotoxicological and environmental risks of pesticides sold, as measured by the pesticide load indicator, from 2011 to 2016. As Denmark relies on imports of chemicals, its policy also focuses on ensuring that imported chemicals and consumer products are safe for the environment and health. To this end, it has developed a high level of expertise in chemical risk assessment, becoming a European and international standard setter in this field. Denmark ranks fifth in the EU for the number of chemical substances assessed and third for endocrine disruptors.

Increased monitoring of chemicals in the environment and in consumer products is the first step in managing their health and environmental risks. This should not, however, be detrimental to the predictive risk assessment of chemicals, i.e. before a negative impact can be detected in humans or the environment. Denmark needs to manage the trade-offs between the two – that is, to ensure efficient sharing of budgetary resources between risk-based monitoring of chemicals and predictive risk assessment. Denmark must also

continue to combine national management of chemicals with participation in international efforts to identify and manage the risks associated with chemicals of concern and compliance concerning high-risk chemicals in products.

Assessment and recommendations

The assessment and recommendations present the main findings of the OECD Environmental Performance Review of Denmark. The 44 recommendations are intended to help Denmark make further progress towards its environmental policy objectives and international commitments. The OECD Working Party on Environmental Performance reviewed and approved the assessment and recommendations at its meeting on 25 April 2019. Actions taken to implement selected recommendations from the 2007 Environmental Performance Review are summarised in the Annex.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1.1. Environmental performance: Trends and recent developments

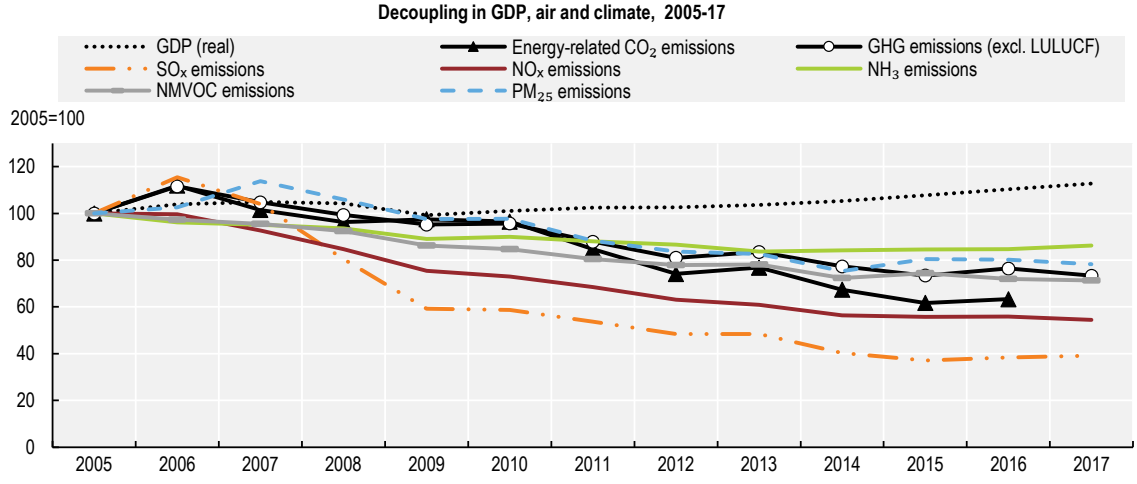
Denmark's[1] population enjoys a very high living standard, one of the lowest income inequality levels in the OECD and strong life satisfaction (OECD, 2017[1]; OECD, 2019[2]). Denmark outperforms the OECD average on most Sustainable Development Goals (SDGs). It has made good progress in decoupling environmental pressures from economic activity. Denmark significantly reduced its greenhouse gas (GHG) emissions over the review period, further progressing in the decarbonisation of its economy. Levels of energy and carbon intensity were among the lowest for International Energy Agency countries in 2017 (IEA, 2018[3]; IEA, 2017[4]). The use of cost-benefit and cost-effectiveness analysis continues to guide environmental policy making.

Despite this progress, Denmark continues to face environmental challenges. In particular, a significant portion of the population of large Danish cities remains exposed to $PM_{2.5}$ levels above World Health Organization standards. Denmark will struggle to meet its target of reducing ammonia emissions, set by European Union (EU) legislation, by 2020. Biodiversity is under pressure in many regions, with a large number of red-listed species, a poor state of conservation of natural habitats and low connectivity of ecosystems. Water quality needs to be improved, especially with regard to the presence of pesticides in groundwater and the ecological status of rivers, lakes and coastal waters.

1.1.1. The country has made progress in decarbonising its economy, with the energy sector playing a key role

Over the review period, Denmark decoupled energy-related CO_2 emissions, GHG emissions and emissions of major air pollutants from growth in gross domestic product (GDP) (Figure 1). The contribution of fossil fuels to total primary energy supply (TPES) dropped significantly, from 82% in 2005 to 60% in 2017.

Figure 1. Denmark has decoupled emissions of GHGs and major air pollutants from GDP growth



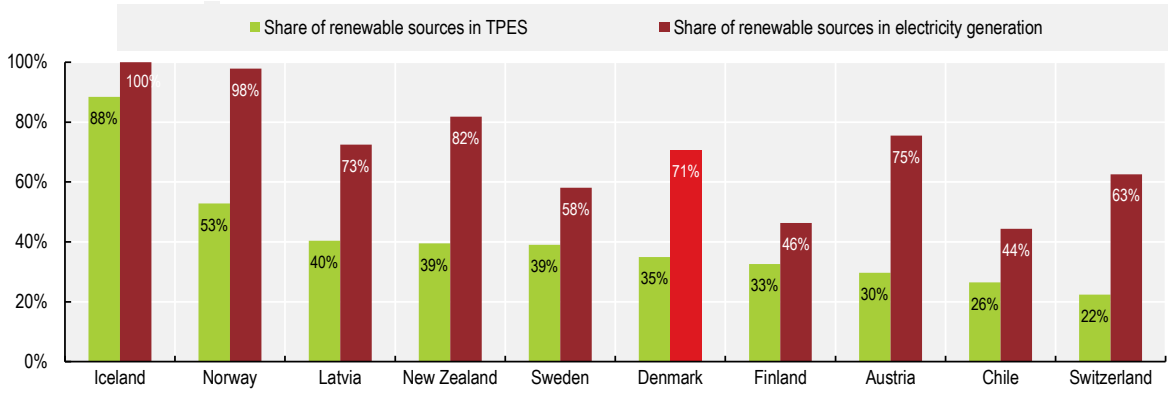
Note: LULUCF: Land use, land-use change and forestry.
Source: Nielsen et al. (2019), *Denmark's National Inventory Report 2019*; EMEP (2019), *WebDab* (database); IEA (2018), *IEA CO_2 Emissions from Fuel Combustion* (database); OECD (2018), *OECD National Accounts Statistics* (database).

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The energy intensity of the economy is among the lowest in the OECD and continued to decline over the review period. Energy consumption decreased by 8% between 2005 and 2016. It fell in all sectors except residential, where it remained relatively unchanged. The largest decrease was in the industry sector (25%). The residential and transport sectors are the largest energy consumers, each accounting for one-third of total consumption in 2016 (IEA, 2018[3]).

Denmark is one of the leading OECD countries in terms of share of renewable energy sources in TPES, even though its hydropower potential is not comparable to other leading countries (Figure 2). Bioenergy and wind have largely replaced coal in power generation. By 2016, Denmark had already met its 2020 renewables target of 30% of gross final energy consumption. However, bioenergy's predominant role in the renewables mix raises the issue of environmental sustainability of supply (OECD, 2018[5]), all the more so since Denmark imports nearly half its solid biomass, more than any other OECD country using this resource.

Figure 2. Denmark is one of the leaders in use of renewable energy sources



Source: IEA (2018), *IEA World Energy Statistics and Balances* (database).

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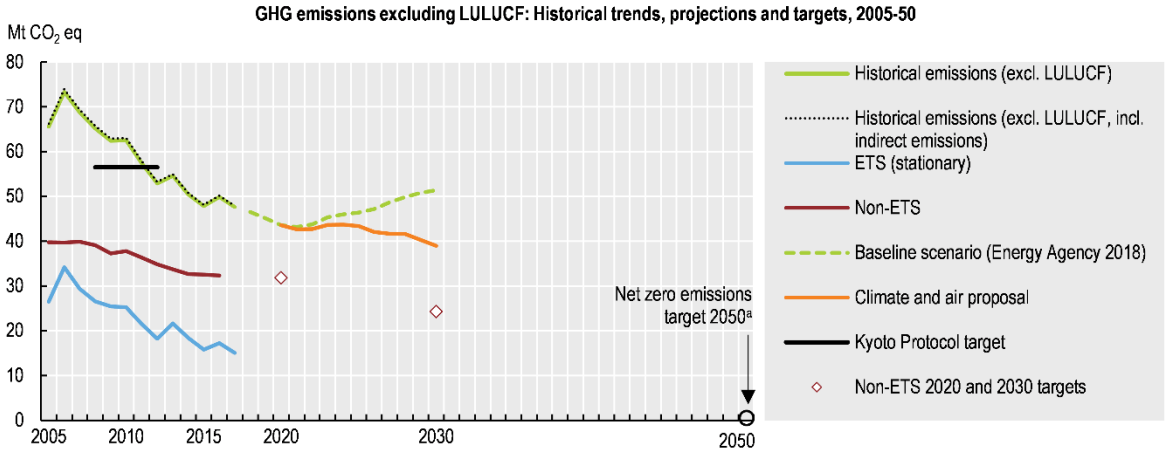
1.1.2. Denmark has stepped up its efforts to mitigate greenhouse gas emissions and is preparing for carbon neutrality by 2050

Between 2005 and 2017, Denmark reduced its GHG emissions by 27.7% (Nielsen et al., 2019[6]) (Figure 3). In June 2018, the government and all parties in the Folketing (the Danish Parliament) agreed a new set of measures to be introduced over 2020-24. This Energy Agreement aims for a 55% share of renewables in primary energy supply by 2030 (Government of Denmark et al., 2018[7]). It specifies that, by 2030, renewables are to cover all final electricity consumption – or even more, allowing for net exports to the European grid – and electricity production from coal is to be phased out. Most of the GHG reductions envisioned in the agreement, totalling 10-11 million tonnes of CO_2 equivalent (Mt CO_2 eq), are covered by the EU Emissions Trading System (EU ETS).

In 2016, emissions covered by the EU ETS accounted for one-third of Denmark's GHG emissions. Between 2005 and 2017, EU ETS emissions from stationary sources decreased by 43%, well above the EU average of 14% (EEA, 2018[8]; Nielsen et al., 2018[9]). The

reduction followed a proactive policy supporting diffusion of renewables, partly financed by an allocation of revenue from the electricity tax paid by Danish households. Under the Energy Agreement, feed-in tariffs will be replaced by technology-neutral one-off investment grants in a move to solutions that are more responsive to changing market conditions. Some DKK 4.2 billion (EUR 564 million) is to be allocated for this purpose from the state budget for 2020-24.

Figure 3. More measures to reduce GHG emissions are needed if Denmark is to achieve its long-term goal



Note: LULUCF: Land use, land-use change and forestry.
a) Including LULUCF.
Source: Nielsen et al. (2019), *Denmark's National Inventory Report 2019*; Danish Centre for Environment and Energy (2018), *Projections of Greenhouse Gases 2017-2040*; EEA (2018), *GHG Data Viewer* (database).

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The EU Effort Sharing Decision commits Denmark to reduce its non-EU ETS emissions by 39% from the 2005 level by 2030. This is one of the most ambitious reduction targets in the EU. Between 2005 and 2017, non-ETS emissions decreased more slowly than EU ETS emissions, by 18% (Eurostat, 2019[10]). Under the Effort Sharing Decision Denmark has chosen for the sake of cost-effectiveness to rely on flexibility mechanisms to achieve the 39% target. Two-thirds of the GHG reductions it envisions for non-EU ETS emissions, about 21 Mt CO_2 eq, are to be achieved through credits in the land use, land-use change and forestry (LULUCF) sector and one-third by cancellation of EU ETS quotas.

In October 2018, the government prepared a climate and air proposal, Together for a Greener Future, to reduce non-EU ETS GHG emissions (and air pollutants). Among other measures, it proposes halting sales of new petrol and diesel cars by 2030 and supporting research and development (R&D) to develop low-GHG farming (EUR 12 million) and carbon capture and storage on farmland and in forests (EUR 14 million). Measures approved in the Finance Act for 2019 include an increased premium for scrapping old diesel cars, grants for investing in low-carbon barn technology and research on better estimating carbon sequestration in soil and forests. To help reach a goal of 1 million electric vehicle sales by 2030, electric and plug-in hybrid cars below DKK 400 000 (EUR 54 000) are exempt from the registration tax in 2019 and 2020, and the government has established a transport commission, giving the municipalities the option to offer cheaper and prioritised parking of green vehicles and allowing them to drive in bus lanes. The Energy Agreement

and climate and air proposal are key steps for Denmark to make its economy climate-neutral by 2050, in line with the long-term EU strategic vision.

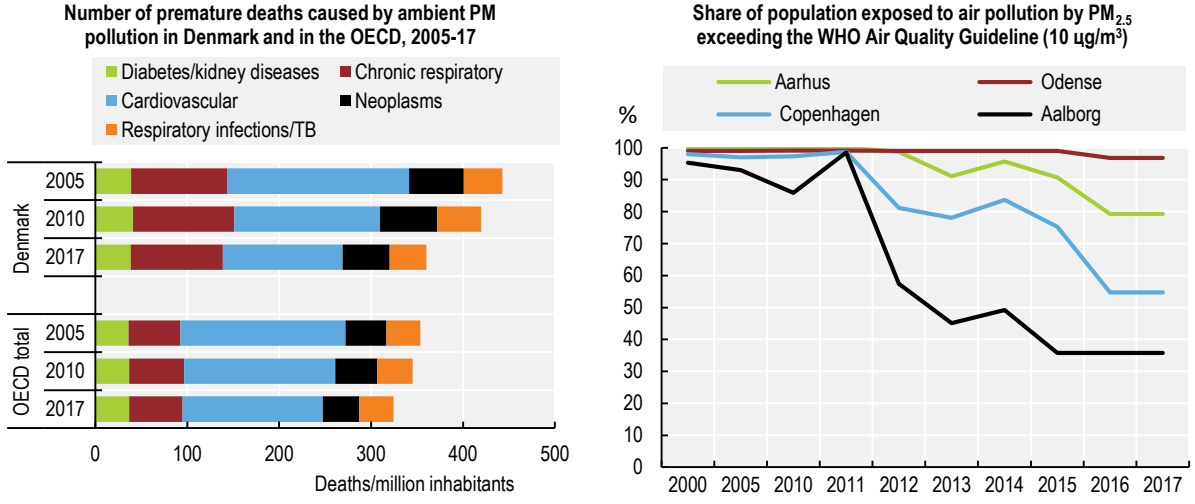
1.1.3. Particle pollution in cities and agricultural ammonia emissions remain problems

Denmark is on track to meet its 2020 targets under the EU National Emissions Ceilings (NEC) Directive for nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs) and sulphur oxides (SO_X). It will be more difficult for it to meet its NEC commitments for 2020 and 2030 on fine particles ($PM_{2.5}$) and ammonia (MEF, 2019[11]). Domestic steps to improve urban air quality include low-emission zones in major cities, registration tax exemption for electric cars, particle filters for new fossil-fuelled cars and enhanced emission limit values for residential wood stoves. Measures have also been taken to reduce ammonia emissions, such as banning manure application by splash plate and a requirement to roof slurry tanks.

Denmark submitted its NEC implementation programme, the National Air Pollution Control Programme, to the European Commission for approval in April 2019. It proposes measures to reduce ammonia emissions, such as financial support for low-emission barns and regulation of urea-based chemical fertilisers. The proposed measures to reduce $PM_{2.5}$ focus on cleaner transport and accelerated replacement of old residential wood stoves.

The number of premature deaths caused by ambient air pollution continues to be above the OECD average (Figure 4). The Danish Center for Environment and Energy at Aarhus University estimates that 3 200 premature deaths a year are attributable to air pollution, including transboundary pollution, with exposure to $PM_{2.5}$ implicated in 90% of cases (Ellermann et al., 2018[12]). The welfare cost related to $PM_{2.5}$ exposure is estimated at 3% of GDP (OECD, 2018[13]).

Figure 4. Good air quality remains a challenge



Source: OECD (2018), "Exposure to air pollution", *OECD Environment Statistics* (database).

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1.1.4. More coherent and proactive policies are needed to foster nature conservation

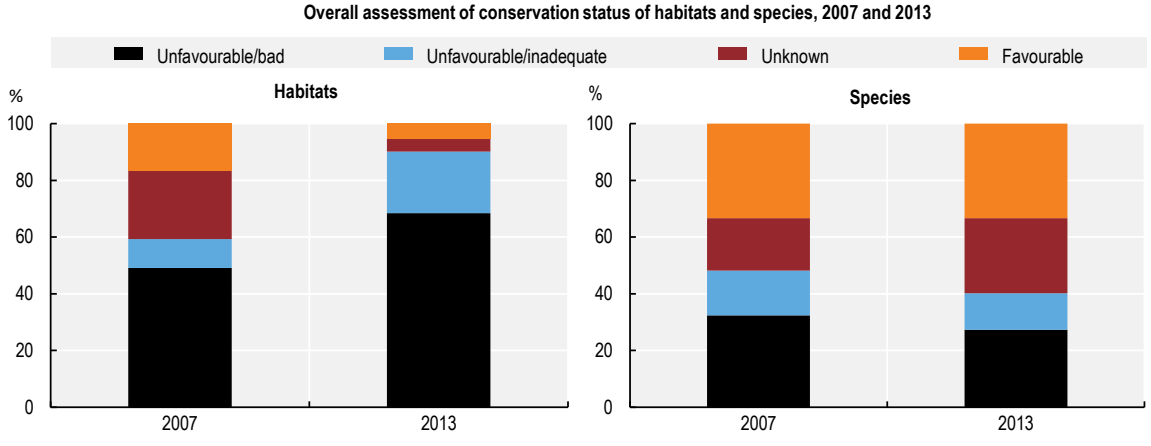
The 2014 Biodiversity Strategy does not include targets for protected areas. The vast majority of open habitats (i.e. natural areas with no tree cover and additionally most freshwater lakes), about 10% of the country's area, are included in Section 3 of the Nature Protection Act, which gives them general protection against activities that can have a direct negative impact on their integrity. This does not mean, however, that some extensive farming practices cannot continue. The area of Section 3 habitats increased by 9% in 2006-16 (EPA[14]).

Until 2008, Denmark had no national parks. Five have since been created, parts of which are privately owned. The national parks are established by assignment agreements and managed at the local level. Their management imposes regulation on specific activities within the parks by designating different planning zones.

The 2016-19 Nature Package envisages increasing the area of "biodiversity forests" from 11 700 ha in 2016 to 28 300 ha in 2066, mainly in state-owned forest. By January 2019, 22 800 ha had been designated in state-owned forests. "Biodiversity forests" have a stricter biodiversity protection target than other forests and have less intensive or no management. The new National Forest Programme, adopted in 2018, builds on the objectives of its predecessor: i) increase forest cover to 20-25% of the land by the end of the century (it is now less than 15%) and ii) make protecting biodiversity the main goal for 10% of all forests by 2040.

Natura 2000 sites cover some 8% of the land area and 18% of the exclusive economic zone. However, 68% of the total area of habitats and 27% of species covered by the EU Habitats Directive are in unfavourable or bad conservation status (Figure 5), and 27% of assessed plant and animal species are red-listed.

Figure 5. The state of most habitats remains unfavourable



Source: EC (2014), National Summary for Article 17 of the Habitats Directive, Report 2007-12.

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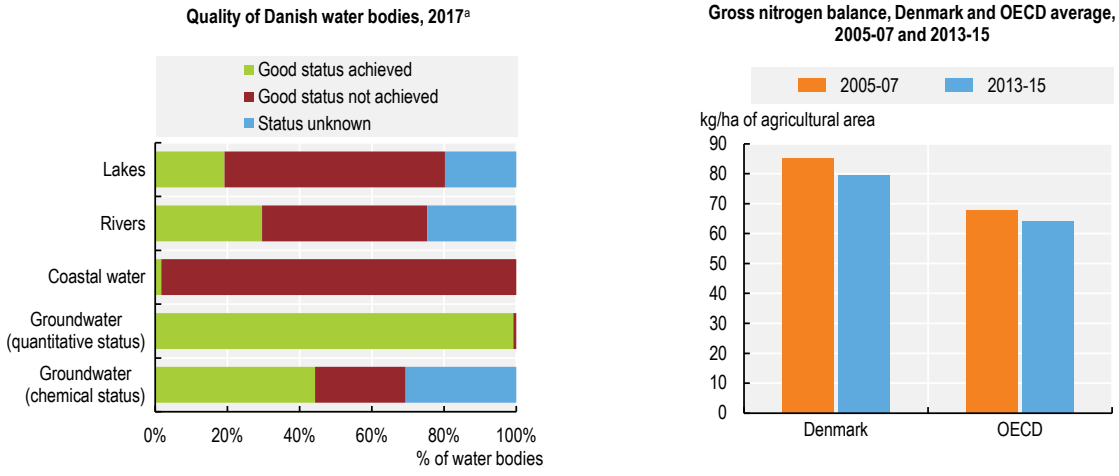
Amendments to the Planning Act in 2015 and 2017 require municipalities to designate the location of areas of special nature protection interest on a map, including Natura 2000 areas on land and other protected natural areas as well as ecological corridors, potential natural areas and potential ecological corridors. The complete designation constitutes the Green

Map of Denmark. Preparation of the Green Map is a key element of Danish nature conservation policy. The map should enable targeting of municipalities' nature protection initiatives. It will be developed gradually as municipalities revise their land-use plans. Once designated, it will provide a clearer picture of the extent and location of existing and potential areas of special nature protection interest and indicate where to create such areas and corridors to link them.

Danish reporting to international organisations has overestimated the number of protected areas compliant with the standards of the International Union for Conservation of Nature (IUCN). Thus any comparison with the Aichi targets under the Convention on Biological Diversity (CBD) is distorted. For example, it would appear that the total number of IUCN-compliant areas protected by specific conservation orders is of the order of 400, rather than the 1 843 previously reported under the CBD. The Ministry of Environment and Food (MEF) estimated in April 2019 that 15% of the land area in Denmark is protected in accordance with the Nature Protection Act or Natura 2000, or both.

Many water bodies do not achieve the good ecological status required by the EU Water Framework Directive (WFD). This is particularly true of coastal waters, the vast majority of which do not achieve the goal (Figure 6). Measures under the 2005-09 Action Plan for the Aquatic Environment III and 2009-15 River Basin Management Plan (RBMP) helped reduce the agricultural nitrogen surplus by 7% between 2005-07 and 2013-15, though it remains above the OECD average (Figure 6).

Figure 6. The quality of coastal waters is of concern and the agricultural nitrogen surplus remains above the OECD average



a) Quality of water bodies according to the standards of the EU Water Framework Directive.
Source: Blicher-Mathiesen et al. (2019), *Landovervågningsoplande 2017: NOVANA* (Agricultural watersheds 2017); EEA (2018), *State of Water Assessment and EU Water Policy Context;* MF (2018), *Fremdriftsrapport på handlingsplanen for implementeringen af verdensmålene* [Progress Report on the Action Plan for Implementing SDGs]; OECD (2019), "Environmental performance of agriculture - indicators", *OECD Agriculture Statistics* (database).

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To achieve the WFD objectives, Denmark needs to reduce nitrogen discharges to coastal waters to 44 700 tonnes a year by 2027, compared with around 60 000 tonnes in 2013-15. To this end, EUR 830 million, just over half the 2015-21 RBMP budget, is devoted to coastal water protection (wetland creation, afforestation, farmland set-asides, catch crops,

ecological focus areas where agricultural production is prohibited), a third goes to wastewater treatment and the remaining 13% is related to lake and river restoration.

The 2015 Food and Agriculture Package introduced a policy shift towards more cost-effective "targeted regulation". Until 2017, Denmark had a regulation where the same rules applied to all farmers. With the targeted catch crops programme from 2017 and targeted regulation from 2019, Denmark has implemented a differentiated system. The targeted regulation is based on water pollution risk. This is a step in the right direction, as it improves cost-effectiveness by focusing efforts on vulnerable areas, in line with the spirit of the WFD and the EU Nitrates Directive. Targeted regulation aims to focus on watersheds threatened by nitrogen pollution, leaving farmers in other watersheds more flexibility in managing the use of their nutrients than was the case with non-targeted regulation (MEF, 2015[15]).

The intensity of agricultural pesticide use is below the OECD average in terms of sales. However the presence of pesticides and their metabolites in groundwater remains a concern. In 2015-17, prohibited (legacy) pesticides were detected in groundwater intended for human consumption at levels exceeding the limit value for drinking water of 0.1 µg/litre in 7.2% of the 1 086 intakes studied. By comparison, authorised pesticides and their metabolites were detected at levels exceeding the limit of 0.1 µg/l in 1.6 % of these intakes (GEUS, 2019[16]). In 2019, municipalities were asked to demarcate protection zones around drinking water wells and enforce them using voluntary approaches. If this proves ineffective, from 2022 a political agreement concluded in 2019 reserves the right to impose pesticide-free agriculture in the protection zones. Some water companies have taken the lead in deciding to pay farmers not to use pesticides in the areas concerned.

Recommendations on climate, air, biodiversity and water

Mitigating climate change

- Make every effort to achieve the goal of further reducing GHG emissions by 2030, including identifying misalignment of sectoral policies with climate policy, mobilising private finance and seeking synergies with other environmental policies (on air, water, waste, biodiversity).
- Develop a vision for a carbon-neutral Denmark by 2050, considering the development and export promotion of technological solutions (for energy efficiency, renewables, and carbon capture and storage) and cost-effectiveness (including using international carbon markets to offset emissions).

Improving air quality

- Redouble efforts to reduce ammonia emissions so as to achieve the 2030 target set by the NEC Directive; in particular, seek synergies with nitrate policies, taking into account the nitrogen cycle; ensure policy coherence between ammonia emission management and expansion of biogas as a renewable energy resource.
- Continue efforts to address urban $PM_{2.5}$ pollution, including reducing particle emissions from residential wood burning.
- Strengthen international co-operation to support Denmark's efforts to control transboundary air pollution from international ship traffic.

Addressing biodiversity

- Update the 2014 Biodiversity Strategy in light of initiatives put in place since its launch (e.g. Nature Package, National Forest Programme, Rural Development Programme, Green Map), and ensure their coherence; pending development of the Green Map by 2050, set intermediate targets for protected areas and connectivity, taking into account progress on the CBD Biodiversity Strategic Plan 2021-30.
- Provide sufficient public financial support to achieve the goal for "biodiversity forests" on both state-owned and private land; evaluate their impact, as well as that of the policy of increasing forest cover, on carbon sequestration.
- Establish a natural area connectivity strategy targeting threatened species, in close partnership with civil society and municipalities.

Improving water quality

- Continue to improve the cost-effectiveness of measures to reduce nitrate pollution of coastal waters; in particular, continue to implement the targeted regulation, focusing on watersheds at risk; estimate the effects of this targeted regulation on N_2O emissions with a view to seeking synergies.
- Improve the effectiveness of voluntary approaches to farmers in preventing pesticide use around drinking water abstraction wells; in particular, incorporate the suggestion that additional instruments will have to be applied if the objective of pesticide-free areas is not achieved.

1.2. Environmental governance and management

Denmark has a well-functioning environmental governance and management system. It is characterised by high levels of co-operation and consensus. Particular assets include an informal system of cross-party political agreements, strong participation by civil society in policy making and high-quality independent advisory bodies. Denmark also benefits from expertise in socio-economic assessment of policies at its universities and in ministries. Finally, it has a comprehensive risk-based inspection system in place.

There is scope to use the existing expertise in socio-economic assessment more systematically in policy making. Despite the strong risk-based inspection system, analysis of non-compliance among companies is limited. Given the important responsibilities of municipalities, strengthening their capacity, including by sharing expertise, in domains and regions where they face environmental problems must be a priority, along with ensuring that environmental rules are applied in comparable ways countrywide.

1.2.1. Municipalities are responsible for most aspects of environmental management

In Denmark's environmental governance and management system, many responsibilities are devolved to the municipalities. The national level sets the legal framework and provides guidance on implementation. It also develops national plans, programmes and strategies. Inter-ministerial co-ordination on environment-related policies at the central level is well established. Following a landmark reform of the local government structure in 2007, Denmark's 98 municipalities became responsible for most aspects of environmental

management. This is consistent with a tradition of municipal autonomy, enshrined in the Constitution. Municipal responsibilities include municipal and local planning; implementation of policies, plans and programmes; the issuance of most environmental permits; and related inspections. National authorities retain oversight on environmental permits and inspections for the most complex and potentially harmful companies. The five regions have limited environmental responsibilities, which the government has proposed to abolish.

As the 2007 OECD Environmental Performance Review (EPR) recommended, task forces were set up to help build municipal capacity following the 2007 reform. The introduction of management planning at river basin level in 2009 improved inter-municipal co-operation in water and nature management. More generally, municipalities share expertise and best practices through Local Government Denmark, an association to which all municipalities belong. Denmark should expand the use of task forces to areas where it faces challenges, such as waste prevention (Section 4). Further guidance on implementation of environmental legislation could be strengthened by learning from international best practice, e.g. Switzerland's "enforcement aids" to its cantons.

1.2.2. Expertise in socio-economic assessment is extensive, but could be used more systematically

Denmark has a good record on the speed and quality of transposition of EU environmental legislation. The number of complaints and infringement cases is low. To enhance political stability and policy continuity, the government often seeks to form political agreements with parties outside government. This system is a major asset for the country. It has helped bring about positive long-term change, such as stable investment in renewables.

Direct environmental regulation is still the most widely used policy instrument. However, Denmark increasingly favours direct regulation based on results rather than requiring specific practices, e.g. in its targeted approach to nitrogen regulation of farms. This gives producers flexibility on how to comply and improves cost-effectiveness (OECD, 2018[17]). Environmental impact assessment is an integral part of the permitting process.

The EU Strategic Environment Assessment (SEA) Directive was transposed into Danish law in 2004. SEAs were conducted on changes to rules on farmers' fertiliser use under the 2015 Food and Agriculture Package and on the siting of offshore windfarms, among other things. Important government plans and programmes typically rely on extensive prior assessment of the cost and benefits of targets or the cost-effectiveness of measures. Denmark also implemented a recommendation in the last EPR by prioritising monitoring of national environmental action plans in its national monitoring programme, NOVANA. Advisory bodies, such as the Environmental Economic Council and the Climate Council, evaluate public policies *ex post* and make *ex ante* recommendations with a strong focus on improving cost-effectiveness. An independent body, Rigsrevisionen, audits public spending on behalf of Parliament.

In 2017, the government revised guidelines on socio-economic impact assessment (SEIA). Making SEIA mandatory on government decisions that would have a significant environmental impact could further enhance the quality of policy making. It would also allow strengthening of regulatory impact assessment (RIA) of draft laws, which have not always been subject to SEIA (OECD, 2018[18]). In addition to effects within its borders, Denmark should consider separately quantifying the effects of its environmental policies in other countries – such as health benefits in neighbouring countries resulting from Danish air pollution measures – and taking them into account in RIA (OECD, 2018[19]).

1.2.3. Land-use planning should target better distribution between agriculture and nature protection

Municipalities are responsible for translating national guidelines into concrete spatial planning. Municipal plans are issued every 4 years and have a 12 year time frame. Local plans are the most detailed level of spatial planning. They establish rules on how land in a local area can be used and developed (OECD, 2018[19]). Spatial planning must take into account existing and potential natural areas designated on the Green Map. The aim is to improve biodiversity by reinforcing efforts to establish larger and more interconnected natural areas and ensure coherence between designations in neighbouring municipalities.

Farmland takes up more than 60% of the surface area and puts pressure on the environment, especially on peatlands (drained peatlands become net GHG emission sources) and near sensitive natural areas and water bodies. Since 1990, land consolidation and land banking have proved essential in improving both agricultural productivity (through structural adjustment) and nature conservation (by offsetting nature conservation land banked with farmland) (Hartvigsen, 2014[20]). However, public funding for land redistribution has been significantly reduced since the structural adjustment policy was discontinued in 2006. In 2018, a Multifunctional Land Redistribution Fund (MLRF) was established with a budget of EUR 33 million. In February 2019, Denmark's two main environmental and agricultural interest groups jointly recommended raising the fund's budget by at least EUR 130 million (Danish Society for Nature Conservation and Danish Agriculture & Food Council, 2019[21]). The aim is to be able to seize opportunities to buy land where farming has a significant environmental impact – e.g. peatlands, farms near ammonia-sensitive nature areas or drinking water wells – and convert it to natural areas or grasslands as well as to support rural development and access to landscapes and nature. This would support Denmark's ambition to achieve net zero emissions by 2050. It would also deliver co-benefits on biodiversity, water and air quality, and climate adaptation. However, determining the merits of scaling up public funding of the MLRF with respect to expected environmental policy benefits requires cost-effectiveness analysis.

In addition to budgetary resources, private funds could be mobilised to finance the MLRF. Denmark has already shown leadership in this area through the Climate Investment Fund. Recent OECD work illustrates the range of interventions public actors can use to attract institutional investment in low-carbon infrastructure, which could include the land purchases envisaged by the MLRF (Röttgers, Tandon and Kaminker, 2018[22]).

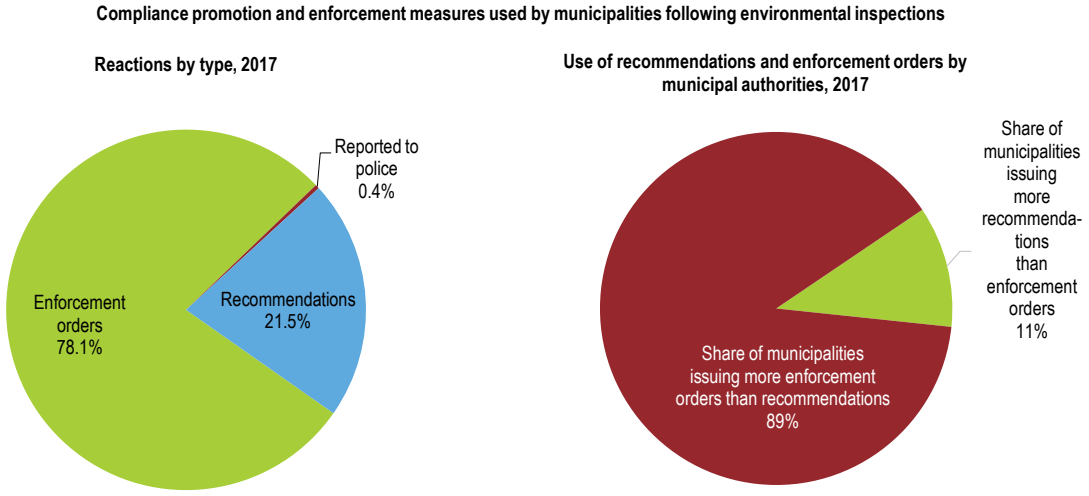
1.2.4. The environmental inspection system is effective, but enforcement is uneven

Denmark applies a risk-based approach to environmental inspections, in line with the EU Industrial Emissions Directive. It assigns a risk score to companies based on five parameters. The most potentially harmful companies are inspected at least every three years, while the least potentially harmful are inspected at least every six years. Denmark applies a risk-based inspection system even to small and medium-sized enterprises (SMEs), which is good practice. In a positive step, a national inspection database called Danish Environmental Administration was set up in 2016. Inspection data from 2017 indicate that the system is effective in finding violations. They also show that the companies posing the biggest potential risks to the environment are subject to the most compliance promotion and enforcement measures. Denmark is starting to use the database more strategically to improve its inspection efforts. From 2020, it plans to target guidance to industries where inspection data point to a need for special efforts to reduce the number of violations.

Making fuller use of the database should help Denmark gain a better understanding of non-compliance among companies and inform policy making.

Authorities have three categories of compliance promotion and enforcement measures at their disposal: reporting companies to the police, issuing enforcement orders to prescribe corrective actions and making non-binding recommendations. Recommendations can take the form of an agreement between authorities and companies on specific improvements to be undertaken. Guidance documents on the use of compliance promotion and enforcement measures have existed since 2005 (EPA, 2005[23]), but in practice, municipalities vary in which measures they use and to what degree (Figure 7). In 2017, recommendations made up 21.5% of all reactions recorded following inspections of the potentially most environmentally harmful companies. However, 11% of municipalities have opted for a more instructive (less punitive) approach by choosing recommendations more often than enforcement orders. Eight municipalities issued five times as many recommendations as enforcement orders.

Figure 7. Compliance promotion and enforcement vary across municipalities



Note: Data refer to inspections carried out by municipalities in the most potentially harmful companies.
Source: Country submission.

To create a level playing field for companies, national authorities should ensure that municipalities promote compliance with environmental rules and enforce them in a comparable manner (Mazur, 2011[24]) while respecting municipal autonomy and taking differences in the regional distribution of industries into account. In 2017, the MEF launched a new enforcement strategy for its agencies, including the Environmental Protection Agency (EPA). The strategy includes scaling up guidance efforts and ensuring transparent and uniform treatment of companies. The results of the strategy should be used to give municipalities additional, evidence-based criteria for identifying appropriate compliance promotion and enforcement measures. In addition, the EPA could illustrate its guidance documents with examples from actual cases in municipalities.

No environmental police or environmental courts exist. Regular police and courts are essentially responsible for imposing fines if violations are reported. However, as municipalities rarely report companies to the police (Figure 7), fines are seldom used. This may indicate that the level of fines is high enough that companies do not expose themselves to the risk of violating environmental legislation. It may also indicate that companies take

seriously the possibility of municipalities escalating the choice of compliance promotion and enforcement measures should violations not be corrected (OECD, 2009[25])

Denmark does not have an environmental code. In 2017, a panel of legal experts recommended simplifying the structure of environmental legislation while keeping the current level of protection. It estimated that the number of environmental laws could be reduced from 95 to 43. Initial steps have been taken to follow up on the panel's recommendations. For example, obsolete rules on agriculture were repealed. Denmark should pursue such efforts to simplify its environmental legislation further in order to promote compliance and enforcement.

Voluntary environmental agreements and formalised partnerships between the public and private sectors are in place. When agreements include quantitative targets, they are backed by the explicit possibility of regulatory action, in line with OECD best practice (OECD, 2003[26]).

1.2.5. Environmental democracy is strong

Public participation in environmental matters is excellent. The Environmental Information Act implements the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (the Aarhus Convention). The act has a broad scope of application. The ombudsman of Parliament, a citizens' watchdog, has contributed to this by issuing opinions on public authorities' use of the act.

In the absence of environmental courts, an appeal board of judges and experts serves as the first instance of redress for citizens and associations against administrative decisions in the environmental field. From 2011 to 2015, it reduced its average processing time for complaints from 369 days to 182, making access to justice quicker. The trend was partly reversed in 2016 when the board was relocated.

Danish authorities use information campaigns to raise public awareness of environmental issues. In recent years, initiatives have been taken to help elementary schools educate children on environmental issues such as the SDGs, climate change, biodiversity and food waste.

Recommendations on environmental governance and management

Supporting the institutional framework

- Expand the use of task forces to build municipal capacity in the areas of environmental management where they face challenges, such as waste prevention.
- Further strengthen guidance to municipalities on implementation of environmental legislation to make it easier to use, as Switzerland does with its enforcement aids to cantons.

Making land use more sustainable

- Evaluate the cost-effectiveness of scaling up land acquisition and redistribution of environmentally valuable agricultural land through the MLRF.

Strengthening policy evaluation framework

- Consider making SEIA mandatory for government policy decisions with a significant environmental impact, including in the context of RIA, based on the 2017 SEIA guidelines.
- Consider separately quantifying effects in other countries when conducting cost-benefit analyses of Danish environmental policies, e.g. health benefits in neighbouring countries resulting from Danish air pollution measures.

Promoting and ensuring compliance

- While respecting municipal autonomy, create a level playing field for companies by ensuring that municipalities apply compliance promotion and enforcement measures based on well-established and similar criteria; in particular, update the EPA compliance promotion and enforcement guidance documents with factual findings from the enforcement strategy and concrete examples from municipalities.
- Continue efforts to make fuller use of the Danish Environmental Administration database on environmental inspections to gain better understanding of non-compliance among companies and to inform policy making.
- Pursue efforts to simplify environmental legislation to further promote compliance and enforcement.

1.3. Towards green growth

1.3.1. Ambitious targets for green growth and commitment to sustainable development

Green growth ranks high on Denmark's political agenda. The country aspires to achieve 100% green electricity by 2030 and net zero GHG emissions by 2050. It is one of the first countries to implement a green energy strategy based on a broad political agreement, which helps create a climate of trust for investors. The commitment to address environmental challenges while ensuring economic success through clean technology exports has made Denmark a pioneer of green growth. Exports and revenue from the Danish clean tech

industry will become increasingly important for the economy as production and associated revenue from oil and gas extraction decline.

Denmark's green growth policy increasingly aims for cost-effectiveness in achieving environmental objectives while ensuring that measures benefit employment and competitiveness. This is reflected in the recently adopted Energy Agreement for 2020-24. Pending transition to electric vehicles and development of mitigation technology for agriculture, Denmark has chosen to make significant use of flexibility mechanisms to achieve its ambitious goal of reducing GHG emissions outside the EU ETS (Section 1). Reaching carbon neutrality by 2050 requires continued investment, R&D in low-carbon technology, and options such as carbon capture and storage and carbon sequestration.

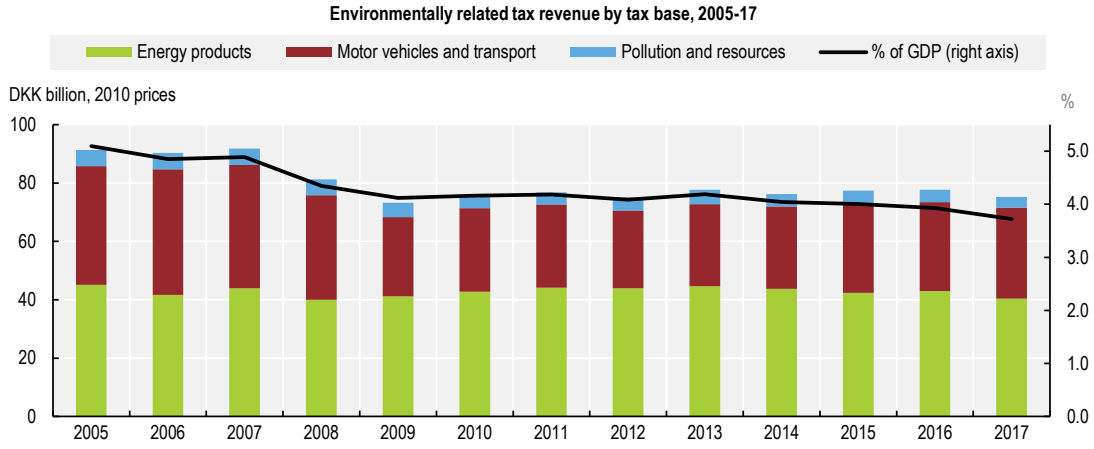
Policy making benefits from engagement of stakeholder and expert groups, which are frequently consulted on major policy initiatives. Denmark played a leadership role in the development of Agenda 2030 and was among the first countries to conduct a voluntary national review on progress towards SDGs. Efforts should continue to broaden the statistical base for SDG reporting and to harmonise key indicators with international ones. A comprehensive report on Green National Accounts for Denmark was published in 2018, comprising information on the natural resource stock, resource use and resulting pollution, and green economy aspects. It could be the basis for regular reporting on green growth.

1.3.2. In a long history of green taxation, adjustments are still necessary

Denmark's public finances are strong. The country is known for balanced budgets and low public debt levels. The tax burden is high: in 2017 Denmark ranked second among OECD countries for tax/GDP ratio, after France. While revenue from environmentally related taxes has declined in real terms over time (Figure 8) because of a decrease in revenue from motor vehicle registration taxes (mostly due to deductions to fuel efficient cars), it still equalled 3.7% of GDP in 2017, the highest share among OECD countries and more than twice the OECD average.

Denmark is a pioneer in carbon pricing. Nearly all energy-related CO_2 emissions face a price signal, except those from burning of woody biomass for heating. The use of bioenergy is assumed to be carbon neutral, in line with EU renewables policy. Overall, 32% of emissions faced a price above EUR 30 per tonne of CO_2 in 2015, which is similar to the OECD average.

Figure 8. Environmentally related tax revenue has declined



Source: OECD (2018), "Environmental policy instruments", *OECD Environment Statistics* (database); EU (2018), National Tax List (NTLs); Statistics Denmark (2019), "Green economy: Environmental taxes", *StatBank* (database).

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Taxes on energy imposed on households, like other environmentally related taxes, are generally much higher than those imposed on businesses, for reasons of competitiveness. The ordinary household electricity tax is the most extreme example: it is some 200 times higher than the rate on manufacturing, etc., making it the highest in the European Union. Denmark has had a deliberate policy of allocating revenue from an additional tax on electricity consumption (the Public Service Obligation, PSO, introduced in 2012) to development of renewables, on a kind of "electricity pays for (renewable) electricity" principle. Although this has disadvantages from a macroeconomic point of view (for example, it limits budgetary flexibility), it has proved effective in supporting wind energy deployment. Without this investment subsidy, combined with feed-in tariffs, the rapid deployment of wind energy technology, and reduction in production costs, would not have been possible.

The new Energy Agreement still provides for wind energy investment subsidies. As the PSO is phased out over 2017-21, the aim is to lower electricity taxes and finance subsidies to wind and other renewables from the general budget. The government's plans to reduce electricity taxes will encourage more people to abandon fossil-fuelled and wood stove heating. The Energy Agreement also gradually reduces the electricity tax on electric heating in a bid to make this option more attractive than fossil fuel and biomass solutions, while reducing the tax burden.

In the context of overall high energy taxes, exemption of woody biomass from the energy duty and CO_2 tax has led to a boom in its use in cogeneration of heat and electricity. However, high reliance on woody biomass is problematic if it leads to unsustainable forest management, including in third countries (almost half the biomass used is imported). Energy utilities have put in place a voluntary programme to ensure sustainable use of biomass, which includes sustainable management of the forests from which the biomass is derived.

As in many other OECD countries, petrol is taxed significantly more heavily than diesel, which is not justifiable from an environmental perspective. Rather than raising diesel taxes, Denmark applies an annual countervailing charge on private diesel cars (in addition to the registration and annual vehicle taxes) in a bid to avoid fuel tourism to neighbouring countries.

However, the charge does not fully offset the low diesel tax, notably for cars driving above-average distances per year. Thus, the charge has not eliminated the effect of the diesel differential. Most trucks, buses and tractors are exempt from the charge or pay a relatively low rate. Denmark would benefit from phasing out the reduced energy duty for diesel, especially if it co-ordinated the phase-out with similar moves in neighbouring countries. End-user prices for diesel are lower in Germany, although higher in Sweden and Norway.

Vehicle ownership is heavily taxed, mainly through the high registration tax. This has led to a relatively low vehicle ownership rate, but has also discouraged renewal of the car fleet: passenger cars in Denmark average 8.9 years, above the EU average (EEA, 2018[27]). The registration tax is differentiated by vehicle fuel consumption. The requirements became more stringent in 2017. The annual vehicle tax is also based on fuel efficiency. Both taxes have been effective in encouraging purchases of fuel-efficient cars. The gradual abandonment of exemption of electric vehicles from the registration tax, combined with a reduction in the rate for all vehicles, led to a drop in electric vehicle sales between 2016 and 2018. Hence it was decided to reinforce the fiscal advantage, at least for 2019 and 2020. Denmark should consider additional measures to support the diffusion of electric vehicles, such as interoperable charging stations (each of the three main operators has its own membership system) or free access to bus lanes, as provided for in the climate and air proposal.

Shifting vehicle taxation from ownership to use would enhance environmental effectiveness. The government has reduced the registration tax several times in recent years while the annual vehicle tax has been increased. These changes have not been accompanied by an increase in the fuel tax or introduction of tolls (other than existing tolls on two bridges and Eurovignette for vehicles over 12 tonnes). Reducing the tax burden on vehicles can have a rebound effect, as fleet expansion reverses the emission reductions achieved by increasingly fuel-efficient cars. Plans in 2012 to introduce a congestion charge in Copenhagen have been replaced by an air quality protection plan to reduce particle and NO_X pollution. For the past ten years, Denmark's four largest cities have been implementing low-emission zones to limit diesel truck traffic in city centres. Only trucks that meet the Euro 4 (since 2010), Euro 5 (from 2020) and Euro 6 (from 2022) standards can circulate. Trucks are not subject to registration tax. The current taxation of trucks fails to internalise the external environmental costs. Previous attempts to internalise such costs (e.g. through road tolls per kilometre driven on certain roads) have been abandoned because they were considered very costly. Public spending on rail has increased considerably to modernise network signalling (DKK 20 billion, EUR 2.7 billion) and electrify the railway (DKK 7 billion, EUR 0.9 billion). Announced in March 2019, a new political agreement on infrastructure investment envisages increasing railway investment in coming years to DKK 51.5 billion (EUR 6.9 billion). In addition, there are plans to buy new electric trains, which could cost as much as DKK 20 billion (EUR 2.7 billion).

The climate and air proposal plans to reduce GHG emissions in non-EU ETS sectors. Its ambition is for all new cars from 2030 onwards to be low- or zero-emission vehicles. A commission for a green transition of all passenger cars has been asked to deliver a strategy on how this ambition can best be realised while maintaining adequate revenue. Meanwhile, a partnership between the government and two large agricultural organisations was established to co-ordinate R&D on GHG mitigation techniques in agriculture and ways to encourage such techniques, in synergy with techniques and policies for managing nitrates and ammonia.

However, Denmark taxes NO_X and SO_X emissions at rates below the indicative values used by MEF for cost-benefit analysis. Its landfill and waste incineration taxes have reduced the amount of waste going to landfill but not the amount for incineration (Section 4). Nevertheless, it is one of the few countries to tax pesticides, and in 2013 it went from a retail value tax to one that reflects health and environmental risks (Section 5). It and the Netherlands were the first countries to regulate nitrogen and phosphorus excess through a quota system at the farm level.

Denmark and the EU co-finance a Rural Development Programme (RDP), under which DKK 1.1 billion (EUR 148 million) a year was spent on environment-related agricultural activities in 2015-19, including green investment in farms, organic farming and protection of nature and water quality. Payments for protection of the aquatic environment increased from EUR 30 million to EUR 100 million over the period, while payments for biodiversity protection remained in the range of EUR 30 million to EUR 50 million. Farms that convert agricultural peatland to nature areas lose income support under the EU Common Agricultural Policy. Denmark thus decided to compensate farmers converting peatland into nature areas, spending DKK 65 million (EUR 8.7 million) annually in 2016-19. Denmark should evaluate the side effects of the RDP measures on GHG emissions with a view to seeking co-benefits. For example, conversion of peatlands could reduce some 15% of agricultural GHG emissions through carbon sequestration (Dubgaard and Ståhl, 2018[28]). Incentives could also be developed to mobilise private investment in carbon sequestration, for instance through development of voluntary or, in the medium term, mandatory offset markets. However, current EU policies limit the potential. The EU 2030 Climate and Energy Framework caps how much member states can use carbon sequestration to meet their GHG reduction targets for non-EU ETS sectors.

1.3.3. Denmark invests in renewables and is a leader in innovation

Denmark has experienced an investment boom in renewables over the last decade, driven by strong political leadership and targeted support policies. Support expenditure for renewables has increased significantly since 2010 due to the growing number of eligible projects (notably in wind energy) and low electricity market prices. More than half of electricity now benefits from public support for investment, market price support and tax breaks (compared to 16% across 26 EU countries), mainly for wind energy and combined heat and power (IEA, 2017[4]). The Energy Agreement provides for a switch to yearly technology-neutral tenders for wind and solar-photovoltaic projects in 2018 and 2019, which will be extended to incorporate more technologies in the coming years, reduce public support and thus improve cost-effectiveness.

Subsidies to biogas plants have reached record levels. However, in early 2019, the political parties that signed the Energy Agreement decided to stop support to new plants under the present support programme as of 1 January 2020 and instead introduce a tender system. Yet biogas does not lack environmental benefits. For example, using manure as a raw material for biogas instead of spreading it as fertiliser reduces the risk of air pollution (ammonia) and water pollution (nitrates), and digested manure is a high-quality natural fertiliser that emits much less nitrous oxide than untreated manure.

Several gas, oil, electricity and district heating companies have voluntarily committed to an annual energy savings target as part of the 2012-20 Energy Savings Agreement. This energy efficiency obligation (EEO) is financed by end consumers through their energy bill, on the "energy pays for energy (saving)" principle. The EEO implements the EU Energy Efficiency Directive, which aims for 20% energy savings by 2020 at EU level, in terms of

primary and final energy consumption. Due to concerns about limited effectiveness and its impact on consumer tariffs, Denmark decided to have the EEO cease in 2021. A new call for tenders will take over and energy saving costs will be financed from the general budget.

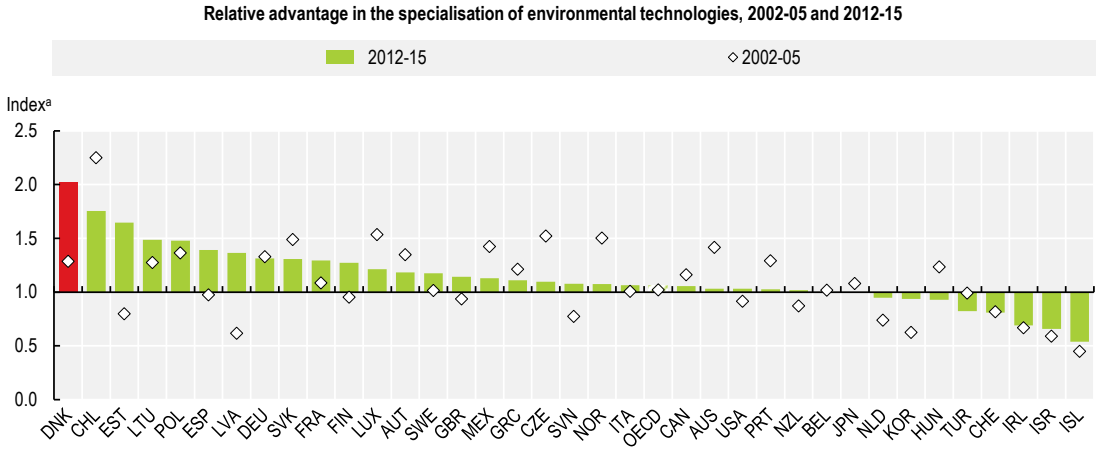
Public expenditure on transport increased by more than 50% in real terms over 2005-16, driven by a large increase in rail infrastructure investment (ITF, 2019[30]). This reflects a commitment in the 2009 Transport Agreement to improve public transport, including an extension of the metro in Copenhagen and financial support to development of light railways in Aarhus and Odense. In addition, in 2014, the government at the time agreed on a DKK 28.5 billion (EUR 3.8 billion) investment in new railways, upgrading of existing railways and electrification of the rail network (IEA, 2017[4]). However, the Train Fund, intended to finance these investments, was later limited in scope. A recent agreement announced an infrastructure investment of DKK 112 billion (EUR 15 billion) for 2021-30. Denmark should consider re-evaluating the proposed project pipeline, as it contains projects that were found to have negative socio-economic effects.

Public spending on environmental protection amounted to about DKK 34 billion (EUR 4.4 billion) in 2017 (SD, 2018[31]), or 1.5% of GDP. This includes expenditure for waste and wastewater management (72%), protection of biodiversity and landscapes (13%) and protection of ground and surface water, air pollution control, and public administration of environmental protection (15%). Most waste and wastewater expenditure is recovered from households through user fees, which is why household spending as a share of total final consumption expenditure (1.6% in 2016) is the highest in the EU (Eurostat, 2019[32]).

High user fees may reflect high quality of service and full cost recovery, but also service provision inefficiency. In the waste sector, for example, municipalities are not required to compete with private companies for waste collection and treatment. In the water sector, cost-effective behaviour is encouraged in the 2009 Water Sector Act, which sets requirements with respect to companies' operating costs based on benchmarking, as well as a price ceiling. Recap regulation has helped halt water price increases and improve utilities' efficiency; tariffs have remained relatively stable since 2009.

Denmark is one of the innovation leaders in Europe, and its patents have the highest level of specialisation in environmental technology among OECD countries (Figure 9). Measured per capita, Denmark ranks second for environment-related inventions, after Korea. The Danish wind industry is recognised as a world leader. The budget for innovation in clean technology was reduced by half over 2013-16 (IEA, 2019[33]). However, Denmark has committed to increasing it again under Mission Innovation. The Energy Agreement confirms this commitment, increasing the clean energy innovation budget to DKK 580 million (EUR 78 million) in 2020 and DKK 1 billion (EUR 134 million) in 2024, bringing it back to 2010 levels. Business R&D spending is highly concentrated in a few large companies; incentives for R&D should also be made available to start-ups, which are often more innovative than their larger counterparts.

Figure 9. Denmark is a leader in green innovation



Note: Patent statistics are taken from the Worldwide Patent Statistical Database (PATSTAT) of the European Patent Office (EPO), with algorithms developed by the OECD. Data refer to patent applications filed in the inventor's country of residence according to the priority date and apply solely to inventions of high potential commercial value for which protection has been sought in at least two jurisdictions.

a) Index of the specialisation in environmental innovation. It is calculated as the ratio of 1) the share of environment-related inventions on all inventions (in all technologies) at home and 2) the share of environment-related inventions on all inventions (in all technologies) in the world. The index is equal to 1 when the country's share of "green" technology is the same as the world's share; an index above 1 indicates a relative technological advantage, or specialisation, in environment-related technology compared to the world value.

Source: OECD (2018), "Patents", *OECD Environment Statistics* (database).

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1.3.4. Dependence on foreign trade is high, as is foreign aid

Denmark has an open economy with high dependence on foreign trade. The transition to a low-carbon, circular economy is seen as an economic opportunity to boost exports of environmental technology and services, notably in energy technology. Clean tech has been the fastest-growing export sector in recent years, supported by Denmark's international reputation as a front runner in green solutions and its strong framework of export promotion and assistance for internationalisation of innovation and commercial activities. Between 2003 and 2013, Denmark granted more export credits for renewables-based power generation projects than any other OECD country, thanks to strong support for wind energy. The government aims to double energy technology exports' value to at least DKK 140 billion (EUR 19 billion) by 2030.

Environment and climate change are well covered in Denmark's official development assistance (ODA). Denmark is one of the few countries that has achieved the UN target of allocating at least 0.7% of gross national income to ODA. The ODA budget was, however, reduced in 2015, affecting environment- and climate-related development finance, which dropped by 44% between 2014 and 2017 in real terms (OECD, 2019[34]). At the same time, the focus has been on enhancing private sector engagement and mobilising private investment. For example, the Danish Climate Investment Fund has committed to support projects with Danish commercial participation and has attracted Danish institutional investors. While this is consistent with global efforts to enhance blended finance, these activities must not come at the expense of untied ODA.

Recommendations on moving towards green growth

Framework for sustainable development

- Continue developing green national accounts, publish them regularly and monitor their use in decision making; strengthen the statistical underpinning of the 2030 Agenda for Sustainable Development at the national level and ensure that indicators are as internationally comparable as possible.

Greening the tax system

- Reduce the energy taxation gap between households and businesses to equalise incentives for energy savings and CO_2 reduction; continue efforts to make electric solutions for heating and mobility more attractive vis-à-vis fossil-fuel-based options.
- Improve alignment of transport taxes with transport-generated externalities; in particular, ensure that lower taxes on vehicle ownership are matched by an increase in taxation of vehicle use (e.g. in congested areas).

Investment in a greener economy

- Continue to gradually phase out subsidies to renewables technology as it becomes economically competitive, and ensure that remaining support is technology-neutral.
- Regularly evaluate the effectiveness of and necessity for biogas subsidies; foster synergies between biogas development policies and nutrient management policies.
- Establish mechanisms to mobilise private investment in carbon capture and storage options, including those arising from peatland rewetting.

Eco-innovation and green markets

- Continue support for and ensure continuity of R&D in energy and other environmentally relevant areas, including climate mitigation options in agriculture and land use. Strengthen opportunities and incentives for more SMEs to engage in R&D.

Development co-operation

- Continue to use ODA to leverage private investment in projects supporting sustainable development, ensuring that it does not come at the expense of untied ODA.

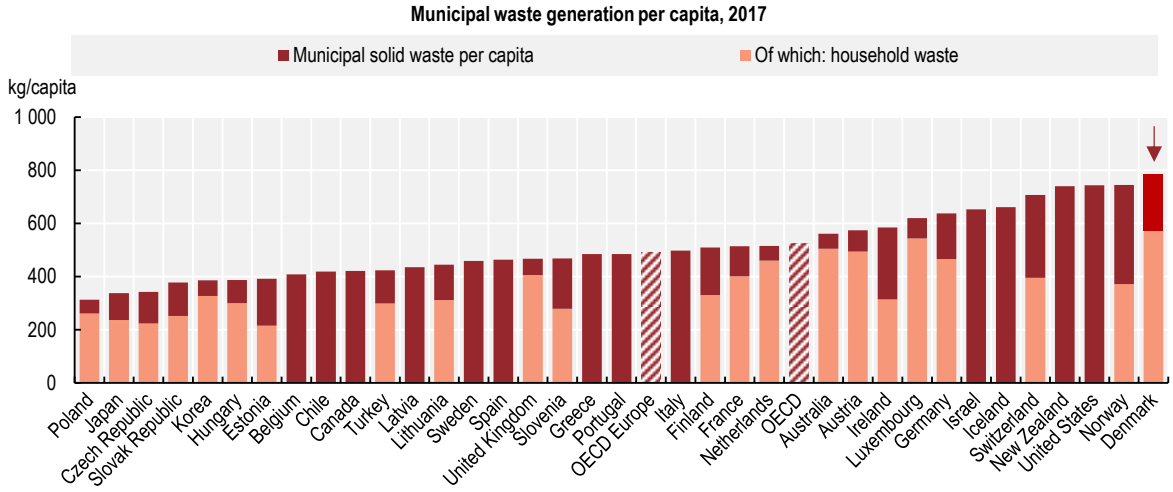
1.4. Waste, materials management and the circular economy

1.4.1. Recycling and recovery rates are high, but so is municipal waste generation

The Danish economy uses a lot of resources. In 2017, domestic material consumption per capita was about 24 tonnes, significantly higher than the averages per capita for OECD Europe (13 tonnes) and the OECD as a whole (16 tonnes). Domestic consumption of materials was decoupled from economic growth in 2008 and subsequent years, coinciding with the economic crisis. However, it has risen again since 2014. About half of national domestic consumption is non-metallic minerals and related to construction. Driven by large-scale infrastructure projects, construction activity is not expected to slow in coming years.

The country is not performing well in terms of waste generation. Total waste generation rose by 30% between 2010 and 2016, to about 20 million tonnes. This increase reflects a rise in construction and demolition waste, which accounted for about 60% of total waste produced in 2016. Municipal waste generation has grown faster than private final consumption, but has been stable since the introduction of a new waste information system in 2010. In 2017, municipal waste generation per capita reached 785 kg, far exceeding the OECD average of 524 kg (Figure 10). Since 2007, Denmark has had the highest levels of municipal waste among OECD countries.

Figure 10. Denmark's municipal waste generation is the highest in the OECD



Source: OECD (2019), "Municipal waste", *OECD Environmental Statistics* (database).

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With regard to waste treatment, Denmark has nearly eliminated landfilling. Municipal waste landfilling fell from 5% to 1% between 2005 and 2017, mainly due to incineration with energy recovery. In addition, Denmark has achieved impressive results in material recovery of most waste streams. In 2016, it recovered 87% of construction and demolition waste, and recycled 73% of industrial waste, 74% of packaging waste and 89% of end-of-life vehicles. Household waste remains a notable exception. Incineration with energy recovery treated about half of municipal waste in 2017; the rest was recycled (27%) or composted (19%). The government estimates that it is on track to reach its goal of

increasing the recycling share to 50% by 2022 for seven household waste fractions (plastic, paper, cardboard, glass, metal, wood, organic waste) considered jointly. Recycling increased from 22% in 2011 to 31% in 2016, the latest year for which figures are available.

The cost of waste management services increased significantly over the review period and is now among the highest in OECD Europe. Total public expenditure (current and capital) on waste management increased by 17% between 2005 and 2016. Waste management costs have increased faster than municipal waste generation.

1.4.2. The policy and legal framework in waste management is well established but future organisation is uncertain

Denmark has a strong policy and legal framework for waste and materials management. The main policies are defined in waste management plans and national strategies, such as Denmark without Waste: Recycle More, Incinerate Less (2013) and the circular economy strategy (2018). The main mandatory targets are derived almost exclusively from EU directives. The national regulatory framework includes a general framework law, the Environmental Protection Act, and a specific regulation, the Statutory Order on Waste. These are complemented by regulations on particular waste streams, treatment methods and specific policy aspects of waste management (waste monitoring, deposit-refund programmes).

Denmark has a long history of stakeholder platforms and think tanks, with numerous councils, advisory boards and partnerships involving public authorities. The National Council on the Bio-economy brings together companies, industry associations and universities to promote development of new value chains. It is working on bio-based products, with a focus on plastics, textiles and construction. The advisory board on circular economy has prepared recommendations for the development of Denmark's circular economy strategy. Partnerships involving industry, businesses and public authorities are set up for a wide range of practical issues related to national strategy implementation (e.g. on green public procurement, collection of waste electrical and electronic equipment [WEEE], sustainable construction, waste prevention, reduction of food waste).

Denmark is well equipped to monitor trends in waste and material management through a robust information system. A waste data system, AffaldsDataSystemet (ADS), launched in 2010, has helped significantly improve data quality with an electronic register for waste collectors, consignees, exporters and importers. Pilot projects under way on material flow accounts, with detailed breakdowns by industry sectors and households, will be useful for enriching information to monitor the transition to a circular economy.

Responsibility for waste management policies is shared between MEF for overall policy objectives (environmental aspects, promotion of recycling, etc.) and the Ministry of Climate, Energy and Utilities for economic regulation of the waste management sector and provision of waste management services.

At the local level, the 98 municipalities have considerable autonomy in waste management planning. Since they are responsible for waste classification, they are largely free to decide on the treatment for a high proportion of total waste. As 82 municipalities own or co-own incineration plants and there is excess treatment capacity, there is a risk that they could be inclined to direct their waste to their incinerator. Municipal incinerators face no market incentives to compete on price, environmental performance or efficiency. Tipping fees range from around EUR 45 to EUR 96 per tonne of waste incinerated. Heavy public

investment in municipal waste incineration has created dependence on steady deliveries of municipal waste and limited incentives for municipal investment in recycling and reuse.

In addition, private companies and industrial sectors have complained that waste classification differs by municipality, resulting in additional administrative burdens for operators. What one municipality considers waste may not be classified as such in a neighbouring municipality. Waste classified as recyclable in one municipality may be considered suitable for incineration in another. This lack of harmonisation makes the playing field uneven for companies operating across municipal boundaries.

The government's 2016 Utilities for the Future strategy proposes an in-depth reorganisation of the waste management sector, with increased competition in incineration and a larger private-sector role in waste collection and recycling. However, discussions on practical implementation are stalled. This uncertainty about the future waste management framework discourages private and public investment in the circular economy.

1.4.3. A diverse policy mix encourages recycling despite incineration dependency, but more incentives are needed for waste prevention

Denmark has been a front runner in diverting municipal waste from landfill. It effectively combines a ban on landfilling of waste that can be incinerated, in effect since 1997, with a landfill tax, the rate of which has been steadily raised. This policy mix also aims to promote energy recovery from waste.

Several taxes apply to incineration: a tax based on the amount of heat produced (waste heating tax), an additional tax based on the energy content, a tax on CO_2 emissions for non-biodegradable waste, and taxes on NO_X and SO_X emissions. Incineration taxes are designed to ensure a level playing field in the energy sector and internalise air pollution and carbon externalities; they also provide an incentive to divert waste towards recycling, although no recent analysis has been made of the impact of incineration taxation on recycling rates.

Waste taxes were initially designed with a high rate for landfilling, a lower rate for incineration and no recycling tax, creating an incentive to recycle. The incineration tax was later redesigned to be closer to energy product taxes. The overall difference between incineration versus landfill taxation was kept the same so as to continue to encourage recycling.

The Danish recycling market is characterised by small facilities recycling materials such as glass, wood, plastic, construction materials, WEEE, metals and textiles. Aside from glass packaging, however, most of Denmark's recyclable waste is exported to recycling centres abroad, including cardboard, plastic, WEEE and treated wood. The fragmentation of recycling markets in Denmark hampers private investment, as does the lack of municipal harmonisation on sorting.

Several municipalities apply volume- or weight-based pricing to unsorted residual household waste. The goal is to create an incentive to reduce waste and recycle more. However, despite the 2015 waste prevention strategy Denmark without Waste II, additional incentives are needed in view of the still high level of municipal waste generated. They are all the more necessary given municipal efforts to fulfil excess incineration capacity, which is not conducive to encouraging recycling and waste minimisation.

Denmark has several extended producer responsibility programmes, in line with EU requirements (e.g. for WEEE, end-of-life vehicles, batteries). In most cases it exceeds the

EU recycling targets. Collection of WEEE, however, remains a challenge, as in other OECD countries, as large quantities remain outside the official collection systems.

In the construction sector, a tax on raw material extraction aims to promote rational use of resources. However, the rate (DKK 5/m^3) is too low to prevent waste generation. In addition, many imported raw materials and non-taxed building materials are available.

The weight-based landfill tax and possibility of recovering demolition waste without a permit (provided it is sorted, unpolluted and treated) favour recovery. Yet reuse of demolition waste, e.g. using concrete and crushed bricks instead of gravel in road repairs, often brings little added value. Several knowledge platforms and networks have been established in an effort to foster higher-quality recovery and selective demolition.

1.4.4. Denmark has reached a new political agreement to move towards a circular economy

Denmark has long paved the way for circular economy approaches by promoting eco-design, clean production, eco-innovation and sustainable consumption. An EPA analysis in 2017 showed that almost 58% of the population pays attention to ecological or organic labels when they look for environment-friendly products. Fifteen partners from municipal, regional and central authorities joined forces to promote green public procurement with purchasing criteria including recyclability and recycled content. This partnership covers 20% of all Danish public procurement. Green public procurement is supported by mandatory purchasing rules for timber, energy-using products and road vehicles.

In addition to product design, which must meet EU requirements, Denmark has introduced instruments to promote circular business models. These include information tools, such as dissemination of good practices (for example, a circular business web portal for SMEs), and financing instruments, e.g. providing support for eco-innovation.

In October 2018, political agreement was reached on a circular economy, with a strong focus on how business can become its engine and how government can help (e.g. through one-stop shops, access to finance, digitalisation). The agreement recalls the objectives of the EU waste directives and notes the commitment of the private sector to increase resource productivity by 40% from 2014 to 2030 and to increase the recycling rate to 80% of total waste by 2030, in accordance with recommendations of the advisory board on circular economy. Large and small businesses are represented on the board, which the government established in 2016.

Recommendations on waste, material management and the circular economy

Reinforce waste prevention as a key priority

- For household waste, expand pricing based on volume or weight – as in pay-as-you-throw programmes – while facilitating recycling and composting.
- Accelerate R&D on sorting and recycling technology and innovative reusable and recyclable materials (e.g. biopolymers).
- Develop policies to minimise output of single-use products, such as plastics.

Foster competition in incineration and better manage excess capacity

- Improve the cost-effectiveness of incineration by reforming municipal waste management, giving companies flexibility to choose where to incinerate their combustible waste and making public tenders mandatory for municipal waste incineration.

Continue efforts to steer the transition to a circular economy

- Harmonise criteria for sorting and collecting municipal waste fractions and consider unifying household and business recyclable waste markets to create economies of scale and encourage investment in innovation and large-scale recycling facilities.
- Foster circular product design by introducing eco-modulation of fees in extended producer responsibility systems, based on recyclability, reparability and reusability.
- Continue encouraging circular design by SMEs (e.g. through training and access to finance) and supporting companies in establishing take-back programmes and circular business models, e.g. with closed loops for products and materials.
- Promote voluntary agreements between business and government on circular economy, ensuring that the objectives go beyond what is required by law.
- Encourage voluntary initiatives and pilot projects to reduce "downcycling" (recycling that produces material of lesser quality and functionality than the original material) in the construction, textile and plastic sectors.
- Secure financing to develop data for circular economy (e.g. green accounts and material flow information for industry sectors).

1.5. Chemicals management

As a small country with few chemical producers, Denmark relies heavily on imports to meet domestic demand for chemicals. Chemical policy is therefore aimed primarily at ensuring that imported chemicals and imported consumer products containing them are safe for the environment and health. To this end, Denmark has developed a high level of expertise in chemical risk assessment, becoming an EU and international standard setter.

The chemical policy framework derives largely from EU legislation, which Denmark has helped shape through its efforts to improve regulation of chemical use both nationally and internationally. There is good synergy and co-operation on policy implementation between public authorities, industry and civil society. Public health and environmental protection issues are at the heart of Denmark's chemicals management policy, which pays particular attention to substitution of hazardous chemicals.

1.5.1. Pressures on health and the environment from chemicals are monitored, yet remain significant

Serious pressures from chemicals on health and the environment persist. A high prevalence of male reproductive disorders (40% of the male population have reduced semen quality) has been linked to exposure to certain chemicals, such as endocrine disrupters (EPA, 2013[35]). Groundwater contamination by pesticides remains a problem (Section 1).

Reducing production and use of chemicals harmful to the environment and health is a strategic objective of the 2014-17 and 2018-21 Chemical Initiatives.

A comprehensive and long-standing monitoring system supports development of chemicals management policies. It includes the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environment, with dedicated programmes, e.g. for groundwater. There is also a pollutant release and transfer register (PRTR), though the number of installations it covers has decreased considerably since 2010. Danish research centres working on endocrine disruptor risk monitoring and prevention have developed biomonitoring programmes; increased public financial support would help fully exploit the centres' potential (Bourguignon, Hutchinson and Slama, 2017[36]). Since 2001, the Danish Consumer Programme has conducted more than 160 surveys to identify chemicals in consumer products and assess their potential risks.

More generally, allocation of public financial support to chemicals management implies handling trade-offs between monitoring of effects on health and the environment, on one hand, and predictive risk evaluation, on the other. The first relates to chemical use while the second refers to the process of identifying regulatory actions needed before a negative impact can be detected in humans or the environment.

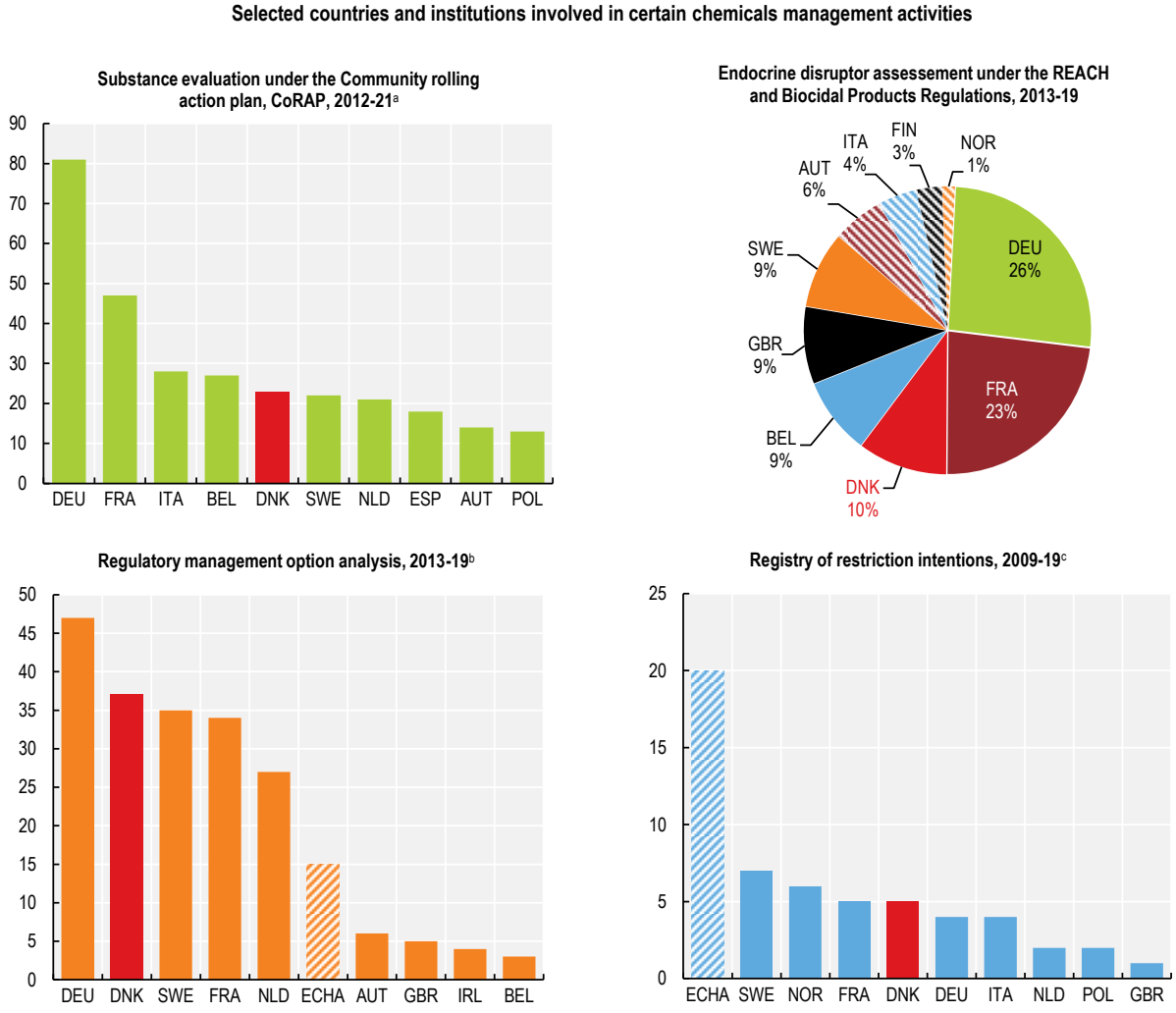
1.5.2. Exemplary policy and institutional frameworks are coupled with stakeholder co-operation

Multi-year policy documents known as Chemical Initiatives set Denmark's national strategies, priorities and objectives for industrial chemicals management (Government of Denmark et al., 2017[37]). Negotiations between the government and political parties outside the government precede the adoption of these policy documents and guarantee a broad commitment (and resources) for their implementation. A first *ex post* evaluation of their effects was carried out in 2017 for the 2014-17 initiative (Sørensen et al., 2017[42]). Denmark should consider making such evaluation standard and improve indicators to track implementation progress. The current occupational health and safety strategy addresses chemicals marginally, which is surprising given, for instance, the important interface between EU industrial chemical and occupational health and safety legislation (Government of Denmark et al., 2011[39]). The prominence of industrial chemicals in the forthcoming strategy on occupational work and safety beyond 2020 should be enhanced.

Denmark has a comprehensive regulatory framework that includes both EU and national instruments, with national rules sometimes going beyond the scope of EU regulations and directives (e.g. on provision of information on chemicals and on hazardous chemical installations). A process is under way to reduce Danish companies' administrative burden, e.g. by avoiding going beyond EU requirements; it has affected the national regulatory framework by, for example, reducing the scope of reporting for the PRTR and green accounts. Nevertheless, Denmark has maintained the ambition of the Chemical Initiatives, whose 2018-21 budget is higher than that for 2014-17.

Denmark remains a standard setter in many areas of chemical policy, including systematic investigation and risk management of chemicals, as evidenced by the high number of chemicals assessed and the country's contribution to regulation and restriction of chemicals at the EU level, among others (Figure 11). It should continue to be proactive in developing chemicals management policies for the benefit of the Danish population and to influence European and other international decision makers.

Figure 11. Denmark is active in evaluation and risk management of chemicals at the EU level



a) The list includes substances that have been evaluated or will be evaluated by 2021 (March 2019). Denmark also co-evaluated one additional substance.
b) The list includes substances for which a regulatory management option analysis (RMOA) either is under development or has been completed.
c) Includes co-submissions.
Source: ECHA (2019), ECHA, Information on chemicals (website), https://echa.europa.eu/information-on-chemicals.

StatLink http://dx.doi.org/10.1787/888934001692

For example, the Danish experience with pesticide taxation could inspire many other OECD countries. In 2013, the taxation in force since 1996 was changed from an ad valorem tax to a differentiated-weight tax based on the effects on health and the environment (Holtze, Hyldebrandt-Larsen and Kühl, 2018[40]). The new tax has four components: a basic tax, a health tax (with rates differing by health hazards), a tax on environmental toxicity (with rates differing by species) and a tax covering persistence, bioaccumulation and leaching. This design has proved effective: it has reduced the pesticide load (in terms of sales) by 40% from the 2011 level. To make it more acceptable, revenue is returned to farmers through a reduction in land taxes.

MEF and EPA are the main institutions responsible for chemical policy, supported by several other authorities. Formal and ad hoc inter-institutional co-ordination ensures stakeholder participation in policy development.

Co-operation of public authorities, industry and other stakeholders has been exemplary and should be continued. Various forums, such as the Special Government Committee for the Environment (in which stakeholders are consulted ahead of EU or international discussion and decisions on chemicals) and the Danish Chemicals Forum, provide a platform for involvement in chemicals management. The public has access to a vast amount of data and information on chemicals. Many campaigns have been held to increase awareness of hazardous chemicals and chemical exposure among the general public and vulnerable populations (Denmark, 2018[41]; Sørensen et al., 2017[38])

The main enforcement authorities are the EPA, the Working Environment Authority and the Maritime Authority. The enforcement strategy is risk based. Since 2015, the enforcement activities of the three authorities in relation to the EU REACH regulation have been aligned with the strategy of the European Chemicals Agency Enforcement Forum. Enforcement in relation to chemicals in products (including imported articles and e-commerce) is a priority area for Denmark (Government of Denmark et al., 2017[37]), and a major challenge. In relation to the assessment work, a reduction in budget transferred to national authorities for their work under the EU REACH regulation is likely following the decrease in EU REACH registration fees. Testing of emergency response plans of hazardous installations has long been a problem (Amec Foster Wheeler, 2017[43]), but a new guideline to address it was issued in 2018.

1.5.3. The country has long been active in international forums and the regional setting

Denmark has always been at the forefront of discussions on chemicals management at the global and regional levels and has given international co-operation an important place in national strategic documents. It continues to contribute actively to the work of international organisations involved in chemicals management, including the OECD, and to UN Environment's Strategic Approach to International Chemicals Management (SAICM) (Denmark, 2018[41]). This leading role should be continued, e.g. in post-SAICM discussions.

Co-operation within the EU has grown in line with the evolution of EU chemical legislation. Denmark also continues to play its part in the development of chemical policies in the Nordic, Arctic and Baltic Sea regions (Denmark, 2018[41]; Governments of Denmark, Greenland and the Faroe Islands, 2011[44]).

Recommendations on chemicals management

Develop innovative tools to help decision making

- Further expand risk-based monitoring of chemicals. For instance, enhance monitoring of legacy pesticides and their metabolites in groundwater and approved pesticides under the Pesticide Leaching Assessment Programme, and consider supplementing it with surface-water monitoring (relevant for biocides). Consider enhanced monitoring of emerging pollutants (e.g. pharmaceuticals in surface water and groundwater) and heavy metals (e.g. zinc in soil and water).
- Strengthen biomonitoring to provide better evidence of people's actual exposure to endocrine-disrupting chemicals and possible effects on human health to support policy making in this area; address trade-offs between monitoring and proactive identification of chemicals requiring regulatory action, taking into account the science-policy nexus (e.g. identification of exposure source).
- Make assessment of the Chemical Initiatives' effects a standard procedure and consider further development such as increasing the use of indicators to track implementation progress.
- Make better use of PRTR data (e.g. for tracking trends in releases or benchmarking among companies).

Implement and influence EU legislation

- Continue identifying national priority areas for strengthened chemicals management and performing an active role at the EU level in identifying chemicals of concern (including the need for substitutes) and assessment of chemicals, including predictive risk assessment (e.g. in relation to endocrine-disrupting chemicals and quantitative structure-activity relationships) and risk management.
- Assess implications of the coming reduction in REACH registration fees on activities that the fees are intended to support in Denmark.
- Strengthen efforts at the national and international levels on compliance assurance for high-risk chemicals in products (including imports and e-commerce), for instance through enhanced co-operation with customs.
- Assess the effectiveness of new measures to strengthen emergency response for the most hazardous facilities (covered by the EU Seveso III Directive).

Notes

[1] The Kingdom of Denmark consists of Denmark and the territories of the Faroe Islands and Greenland. Unless otherwise specified, "Denmark" refers to continental Denmark.

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Annex 1.A. Actions taken to implement recommendations from the 2007 OECD Environmental Performance Review of Denmark

Recommendations	Actions taken
Environmental performance: Trends and recent developments	
Continue to improve energy efficiency (e.g. transport and building sectors, public sector, distribution companies). Review energy taxation to establish appropriate price signals.	Political agreements from 2012 and 2016 oblige grid companies (including electricity, district heating and gas distribution companies), which provide energy directly to retail consumers, to report a certain amount of energy savings annually. Other actions taken to improve energy efficiency include a Knowledge Centre for Energy Savings in Buildings, more stringent requirements for energy efficiency in government buildings and a requirement for energy consumption in new construction to be reduced by 75% in 2020 compared with 2006 figures. An evaluation of energy taxation and energy subsidies (feed-in premiums, feed-in tariffs, contracts for difference to off-shore wind farms, fixed yearly subsidies and one-off investment support) was performed, and as a result, it was decided to lower electricity taxation to make electric heating and electric cars more attractive vis-à-vis fossil-fuel-based solutions. Electricity taxes for industry were reduced, widening the gaps in energy prices across users.
Ensure that cost-effective domestic measures will contribute to meet the Kyoto Protocol's greenhouse gas emission reduction target, especially in sectors not covered by the EU Emission Trading Scheme. Accelerate afforestation.	Covered by the EU Emissions Trading System (EU ETS), the energy sector delivered most domestic greenhouse gas (GHG) reductions. Measures have also been taken for sectors outside the EU ETS. In particular, fuel efficiency has been added as a criterion for setting the level of the vehicle registration tax and the annual vehicle tax; public financial support has been provided for the conversion of farmed peatland into natural areas, biological coverage of old landfills and afforestation.
Assess and reduce disparities in exposure to pollution.	In 2019, the Environmental Economic Council assessed disparities in exposure to $PM_{2,5}$ and NO_2 pollution. It found that income inequality played a limited role in explaining disparities in exposure to air pollution in Denmark.
Continue to reduce emissions of NO_x and VOCs from mobile sources, including through the use of economic instruments in the most cost-effective way.	Taxes on NO_X were introduced on road fuels (DKK 5.2 per kg in 2019) and for vehicles without a particle filter, via the annual vehicle tax (DKK 1 000 in 2019). The countervailing charge on diesel vehicles was raised.
Strengthen the management of particulate matter, including the monitoring of PM_{10} and $PM_{2,5}$ concentrations and emissions. Develop emission standards for residential wood burning stoves. Implement and enforce low emission zones in cities.	Emission standards for new residential wood-burning stoves were introduced in 2008. In 2015, it was decided to strengthen the emission values. In 2019, Denmark introduced a scrapping programme for wood-burning stoves produced before 1995. The Environmental Protection Agency has conducted information campaigns on proper wood burning. The eco-innovation programme supports R&D for technologies that reduce air pollution from wood stoves and boilers. Low-emission zones were introduced in 2010 in the four largest cities. In 2019, the rules were tightened, so that diesel trucks, buses and vans will gradually be required to either meet Euro VI emission standards or have a particle filter to circulate in low-emission zones.
Continue to encourage the provision of economically and environmentally attractive public transport systems in urban areas. Strengthen transport demand management to limit passenger car use in congested areas. Implement the Bicycle Strategy 2007. Address air pollutant emissions from ships.	It was decided to build tram networks in Copenhagen, Aarhus and Odense. The Bicycle Strategy 2007 was implemented, and a new strategy was adopted in 2014. New international regulations and enhanced national surveillance have reduced sulphur air pollution caused by international shipping. Denmark passed legislation to make public certain violations of the sulphur act.
Integrate transport and environmental policies. Set quantitative targets, further use demand-side management, and facilitate co-operation among state and territorial authorities and concerned parties.	A number of transport enterprises and municipalities set voluntary short-term CO_2 reduction targets as part of a green certification programme. Since 2012, the mandate to blend biofuels in road fuels has been raised to 5.75%. In 2018, Denmark expressed an intention to phase out sales of fossil fuel cars by 2030 and plug-in hybrid cars by 2035.
Develop a sustainable transport plan as a follow-up to the forthcoming national sustainable development strategy.	Denmark launched a sustainable transport plan in 2008. The following year, a green transport policy agreement was concluded, allocating DKK 57 billion to public transport investment.
Speed up identification of areas at high risk of nutrient and pesticide contamination and take measures to protect them, including establishing groundwater protection zones, 10-metre buffer zones along rivers, and buffer zones around lakes.	Groundwater mapping identified 7 000 km^2 of nitrate- and pesticide-sensitive areas. A ban on spraying pesticides, fertilising and cultivating soils in a 25-meter zone around drinking water boreholes has been introduced; in 2019, Denmark aimed to extend the protection zone. Buffer zones of 9 meters along rivers and lakes were removed in 2015 and replaced by nitrogen regulation targeting coastal waters threatened with eutrophication. The first part of targeted regulation, targeted catch crops, was introduced in 2017. Differentiation of farmers' nitrogen quotas began in 2019.

Reinforce the interface between water management and nature protection, in the wake of local government reform and pursuant to Action Plan for the Aquatic Environment III objectives. In particular, speed up creation of new wetlands and define ecological quality objectives for rivers.	Aquatic Action Plans and subsequent River Basin Management Plans (RBMPs) have led to the establishment of new wetlands. RBMPs set ecological quality objectives for all rivers, lakes and coastal waters. In 2018, a Multifunctional Land Redistribution Fund was established to foster the protection of nature and water on farmland.
Move toward river basin management according to the new water districts. In particular, prepare water plans as required by the EU Water Framework Directive.	Denmark prepared and implemented RBMPs for 2009-15 and 2015-21.
Establish national parks in priority conservation areas and clarify their role in relation to other protected areas. Complete management plans for all protected areas including the Natura 2000 areas, incorporating biodiversity objectives and ecological integrity indicators, and establish a network of corridors linking them. Develop and adopt ecosystem quality objectives for terrestrial and aquatic habitats, including as part of implementation of the EU Habitats and Water Framework Directives.	Five national parks were established by assignment agreements, managed at the local level. They impose regulation on specific activities by designating various planning zones. Natura 2000 plans for 2010-15 and 2016-21 were adopted, including detailed biodiversity objectives. All 252 Natura 2000 areas have their own management plan. A basis for a network of biodiversity corridors was established with the Green Map of Denmark. Quality objectives for terrestrial and aquatic habitats were developed in the Natura 2000 Plans and the RBMPs.
Develop time-bound objectives for the national nature and biodiversity conservation action plan, including with regard to integration of biodiversity considerations in agriculture, fisheries and other sectoral policies. Develop and implement a comprehensive planning system, with a sea use planning component and with cumulative impact assessment and climate change impact scenarios.	The headline objective of Denmark's 2014 biodiversity plan was to stop biodiversity loss by 2020.According to Denmark's sixth report to the Convention on Biological Diversity in 2019, ambitious new goals for nature should guide the development of a new National Strategy for Biodiversity. Involving farmers in biodiversity promotion is a goal of both the 2014 biodiversity strategy and the 2016 Nature Package. Denmark regulates reef fisheries in Natura 2000 areas. A law on maritime spatial planning integrating environmental protection with planning for economic activities at sea, such as offshore energy, fisheries and raw material extraction, entered into force in 2016.
Expand restoration projects for major ecosystems, including major rivers and future national parks, to re-establish their capacity to produce ecological services and to support biodiversity.	Action was taken to restore watercourses, including by re-establishing naturally meandering courses; EUR 85 million was allocated to watercourse restoration in the RBMP for 2015-21.
Include the public health benefits of access to nature and outdoor recreation as an integral part of national environment and health action plans.	Public health benefits of access to nature and outdoor recreation were included in plans on physical activity and mental health prepared by the Ministry of Health in 2012, and in the political agreement on a Nature Package in 2016.
Place higher priority on marine protection, including marine ecosystem protection. Take further steps to reduce the discharge of toxic substances and nutrients. Ensure that Denmark's international commitments are achieved.	Denmark designated more Natura 2000 areas at sea. The Danish offshore oil and gas industry reduced releases of oil and chemicals to the North Sea. Nitrogen discharges to coastal waters were reduced by around 10% from 2005-07 to 2013-15, in accordance with Denmark's commitments under the Convention on the Protection of the Marine Environment of the Baltic Sea Area.
Pursue efforts towards the sustainable management of commercial fisheries and aquaculture.	The sustainability of commercial fisheries improved, but some fish stocks are still overexploited, especially in the Baltic Sea. More than 80% of Danish fishing is certified by the Marine Stewardship Council. A 2014-20 aquaculture strategy aims at making the sector more sustainable.
Continue efforts to ensure appropriate implementation of multilateral environmental agreements involving trade (ozone-depleting substances, hazardous substances, chemicals, endangered species).	Denmark worked actively for appropriate implementation of multilateral environmental agreements at national, EU and international level. It contributed financially to the multilateral fund of the Montreal Protocol and to the Basel Convention Trust Fund. In 2019, Denmark issued a new statutory order on the national implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
Accelerate the ratification of international environmental agreements already signed.	Denmark ratified a number of international agreements, e.g. the Minamata Convention (mercury), the Hong Kong Convention (ship recycling), the Nagoya Protocol (genetic resources) to the Convention on Biological Diversity and the Gothenburg Protocol (acidification, eutrophication and ground-level ozone) to the Convention on Long-Range Transboundary Air Pollution.

Environmental governance and management	
Further develop the environmental strategic and planning framework with specific environmental quality objectives as well as targets and deadlines, in the context of the sustainable development strategy. Pursue efforts to use cost-benefit and cost-effectiveness analyses in policy setting and implementation.	The national sustainable development strategy (2014) includes seven specific and time-bound environmental targets. The 2017 Action Plan on the Implementation of the Sustainable Development Goals includes ten environmental targets; those of a general nature still include specific indicators. Denmark uses cost-benefit and cost-effectiveness analysis extensively. Regulatory impact assessment has to cover environmental impacts.
Continue to make use of cost-benefit analysis and economic valuation in environmental health policy making; and derive relevant priorities for action.	Cost-benefit analysis was used actively, e.g. when deciding to tighten regulations on low-emission zones in cities to limit air pollution. The average adult value of statistical life was raised from EUR 2.5 million to EUR 4.1 million, which is high by OECD standards.
Set up capacity building mechanisms to help municipalities carry out new environmental management tasks resulting from the territorial government reform. Foster exchange of expertise among municipalities.	The national level helped build capacity and foster exchange of expertise among municipalities through a number of task forces dedicated to various environmental management tasks.
Prioritise monitoring of national environmental action plans.	Denmark prioritised monitoring of national environmental action plans in its National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environment (NOVANA).
Carry out a comprehensive assessment of the economic efficiency and environmental effectiveness of water pollution abatement measures in different sectors (municipal, industrial, agricultural), in the context of implementation of the EU Water Framework Directive.	Comprehensive cost-effectiveness assessments of pollution abatement measures in the agriculture, municipal and industrial sectors were carried out in preparation of the Aquatic Actions Plans and RBMPs.
Accelerate the rate of environmental certification of fish farms.	A 2016 Growth Plan for Aquaculture seeks to modernise the fish farm sector with incentives to change to sustainable production methods. In 2019, 26 of the 166 fish farms were certified by the Aquaculture Stewardship Council.
Continue to promote environmental democracy through access to environmental information, public participation, and access to courts for citizens and associations (e.g. environmental NGOs).	The 2017 amendment to the Environmental Information Act (2000), which transposes the Aarhus Convention, aims to improve access to environmental information through better information on the state of the environment (the next quadrennial report on the state of the environment is planned for 2019). Civil society stakeholders are actively involved in policy making, e.g. through advisory boards, including in the preparation of primary legislation. Processing times for complaints against decisions of public authorities were lowered.
	Towards green growth
Continue to rely on and, where relevant, expand the use of environmental taxes to internalise externalities. Adjust tax rates for inflation. Reduce tax concessions and the associated administrative cost of their implementation.	A number of environmental taxes were introduced or adjusted to better reflect externalities. In particular, Denmark has increased and harmonised the CO_2 tax (EUR 23/t CO_2 in 2018 for most users), introduced a NO_X tax in 2010 and reformed the pesticide tax in 2013 to align it more closely on environmental and health externalities. The energy duty and taxes on NO_X, CO_2 and SO_X were adjusted annually to a consumer price index. Industry continues to enjoy sizeable environmental tax concessions.
Adopt a national action plan for promoting environmental technology based on appropriate economic analysis, and implement it.	In 2009, Denmark adopted an action plan to promote environmental technology. Steps have been taken in development and demonstration, export promotion, sector-specific growth plans and industry partnerships on air and water technologies.
Consider the further use of economic instruments to address diffuse pollution. Target fiscal incentives to environmental outcomes and improve cost-effectiveness.	Direct payments to farmers to reduce diffuse water pollution as part of the Rural Development Programme (RDP) increased from EUR 27 million in 2015 to EUR 82 million in 2019. A targeted nitrogen regulation, initiated in 2017, allows geographically differentiated regulation (depending on the risk of eutrophication in downstream coastal waters) to improve cost-effectiveness.
Increase the efficiency of public water supply and waste water management, in particular by exploiting economies of scale in the wake of local government reform and pursuant to the proposed water reform objectives.	Water utilities have improved their efficiency since the introduction of tariff regulation (the introduction of a ceiling for user charges) in 2017. The amendment of the Water Sector Act (2009) in 2017 also set operating costs requirements based on benchmarking.
Adjust the levels of economic incentives and revise the land use legal framework, so as to enhance biodiversity conservation, production of ecological services (e.g. reduction of nitrogen and phosphorus leaching) and groundwater protection (e.g. in priority contaminated areas) on private land.	Under the RDP, Denmark provides financial support to landowners for the reduction of water pollution and, to a lesser extent, for the protection of biodiversity. Support rates should not exceed costs and income foregone. The Green Map of Denmark was introduced in 2017 to strengthen biodiversity protection in municipal spatial planning.
Continue to examine the existing support schemes from the point of view of their environmental effectiveness and economic efficiency.	Financial support for renewable energy was subject to a major evaluation exercise in order to propose support levels better aligned with electricity market prices. In 2014, the EU Agricultural Fund for Rural Development assessed the Danish RDP support programmes in terms of environmental effectiveness. Denmark assessed the

	cost-effectiveness of environmental technologies in the framework of the Energy Technology Development and Demonstration Programme and the Danish Eco-innovation Programme.
Review existing transport taxes with a view to restructuring them in a more environmentally friendly way (e.g. taxing both car use and ownership; removing the tax break for commuting). Consider the introduction of road pricing as a means to halt congestion.	Denmark lowered its high vehicle registration tax, and strengthened requirements for discounts for fuel-efficient vehicles. In 2012, the project to introduce a congestion charge in Copenhagen was abandoned and replaced by a political agreement to lower the price of public transport by EUR 67 million and to invest an additional EUR 67 million yearly in public transport. The excise tax on diesel fuel used as road fuel continues to be lower than the excise duty on gasoline. Denmark considers this differential tax rate to be a tax expenditure. A compensatory fee (countervailing charge) has been applied to certain diesel vehicles since 2017.
Continue to play an exemplary role in international environmental protection including through development aid. Continue to contribute to sustainable development and capacity building in developing countries through environmental technology exports and other measures (e.g. support for environmental education and awareness programmes).	Denmark reduced official development assistance (ODA) going to environmental projects as part of a general reduction of ODA towards the United Nations target of 0.7% of GNI. At the same time, it has strengthened technical co-operation among governments and increased private sector participation to mobilise private investment for sustainable development projects through the Investment Fund for Developing Countries (established in 1967).
Waste, materials management and the circular economy	
Step up efforts to promote more sustainable consumption patterns (e.g. concerning waste, transportation, land use) by adopting appropriate regulatory and economic instruments, and by focusing on demand management.	Denmark has increased the recycling of household waste and aims to bring added value to construction waste (e.g. reusing bricks in construction rather than crushing them for use as road materials). Despite some initiatives on waste prevention, in particular related to food waste, municipal waste generation per capita is still the highest in the OECD. Denmark supports the transition to a circular economy through green public procurement, eco-labelling and facilitating SME access to information, demonstration project grants and blended finance. The continuation of the long-established "Five Finger Plan" contributes to the coherence of urban development and urban transport planning in the Copenhagen area.
Continue efforts towards appropriate dismantling of Danish end-of-life ships.	Denmark has supported international efforts to promote ship dismantling by ratifying the Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships (which has yet to enter into force) and implementing Regulation 1257/2013 of the EU on ship recycling.
Chemicals management	
Set up additional targets concerning environmental factors related to health with related indicators. Continue to understand better through research and studies the potential links between environmental pollution and chronic illness or child health issues. Take action where there is knowledge (e.g. particulate pollution).	In 2013 Denmark set a target of reducing the pesticide load by 40% from the 2011 level in terms of sales by 2015. A 2016 evaluation showed that the target had been met since 2014. Support for research on the health impacts of environmental factors was continued, e.g. under the Centre for Endocrine Disrupting Substances, the National Allergy Research Centre and via biomonitoring. The results were used to support further action under the EU Regulation on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH). Agreements called Chemical Initiatives are important policy frameworks, targeting children and other vulnerable groups. For instance an evaluation was performed of total exposure of children to selected substances that are hormone disruptive, suspected hormone disruptive or neurotoxic. Among other things, Danish research led to EU-level restrictions on the use of phthalates in 2018.

Part I. Progress towards sustainable development

Chapter 1. Environmental performance: Trends and recent developments

Denmark has made visible progress in decoupling environmental pressures from economic activity. Yet the country is still facing a number of environmental pressures that create challenges on its path towards green growth and sustainable development. This chapter provides a snapshot of key environmental trends in Denmark. It presents the main economic and social developments and the country's progress in making the transition to an energy-efficient, low-carbon and resource-efficient economy and in managing the natural asset base. The chapter also summarises key policy developments in specific areas, including energy, climate, air, biodiversity and water.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1.1. Introduction

Denmark[1] has a small open economy with gross domestic product (GDP) per capita well above the OECD average and income inequality among the lowest in the OECD. Its population enjoys a very high living standard and life satisfaction.

On the environmental front, Denmark decoupled greenhouse gas (GHG) emissions from economic growth over the review period (since 2005). It also made impressive progress towards decarbonising its energy sector: its energy intensity and carbon intensity are among the lowest for any International Energy Agency country. Denmark is a top performer in the share of wind power in electricity generation (IEA, 2017[1]).

Yet it still faces a number of environmental pressures. Danish citizens remain exposed to levels of fine particulate matter ($PM_{2.5}$) above World Health Organization standards and the country is struggling to meet its target of reducing ammonia emissions under EU legislation. Biodiversity is strained in many regions, reflecting a large number of red-listed species, a poor state of conservation of natural habitats and low connectivity of ecosystems. Water quality needs to be improved, especially with regard to the presence of pesticides in groundwater and the ecological status of rivers, lakes and coastal waters.

This chapter provides an overview of Denmark's main environmental achievements and challenges on its path towards green growth and sustainable development. Drawing on indicators from national and international sources, it reviews progress on national policy goals and on international commitments and targets, focusing on the period since 2005. To the extent possible, it compares the state of the environment and key environmental trends with those of other OECD countries. The chapter sketches out major policy developments in environmental sectors including air, climate, biodiversity and water.

1.1.1. Progress towards the Sustainable Development Goals

Denmark co-chaired the 2015 UN Sustainable Development Summit that adopted the 2030 Agenda for Sustainable Development. In 2017, the Danish government approved an action plan that translates the Sustainable Development Goals (SDGs) into five priority areas: prosperity, people, planet, peace and partnerships. The action plan contains national targets and indicators to monitor progress in achieving them. A first annual progress report was published in 2018 and a more comprehensive status report will be prepared every four years (MF, 2017[2]).

Relative to the OECD average, Denmark outperforms on most SDGs. It has already met 26 of the 94 SDG targets for which indicators are available, and the distance to target is small for most others (OECD, 2018[3]). However, as in other Nordic countries, key challenges on the road to 2030 are linked to the greening of agricultural systems, material consumption levels and ecosystem conservation (Larsen and Alslund-Lanthén, 2017[4]).

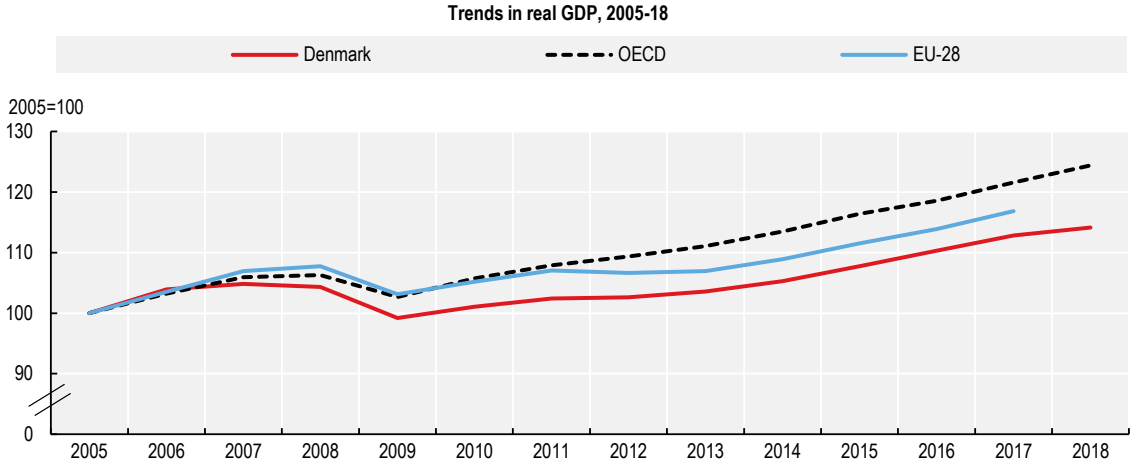
1.2. Main economic and social developments

1.2.1. Economic performance

Denmark has a rich and open economy. It ranks eighth among OECD countries for GDP per capita and maintains a large trade surplus (MEAI, 2018[5]). However, over 2005-18, GDP growth was below the OECD average (Figure 1.1) and the GDP per capita gap fell from 26% to 18% (OECD, 2018[6]). GDP per capita returned to pre-2008 economic crisis levels only in 2016 (OECD, 2019[7]). GDP growth is projected to decelerate to 1.9% in

2019 and 1.6% in 2020. In terms of financial balance, Denmark has not returned to pre-crisis conditions (5% of GDP surplus) but is gradually returning to equilibrium, although a slight deficit is expected in 2020 and 2021 (OECD, 2018[8]). The 2019 OECD Economic Survey points to the need to boost productivity growth, adapt to the challenges posed by new technology and improve the efficiency of the public sector (OECD, 2019[7]).

Figure 1.1. GDP per capita remains high, but GDP growth lags behind the OECD level



Source: OECD (2019), *OECD National Accounts Statistics* (database).

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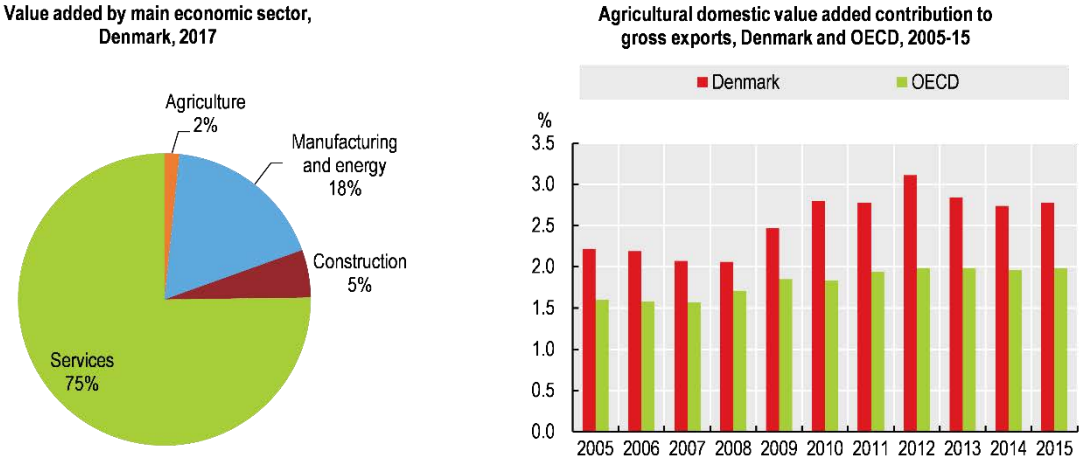
1.2.2. Structure of the economy and employment

The economy is dominated by the service sector, which accounted for three-quarters of value added in 2017, above the OECD average; industry accounted for most of the rest (Figure 1.2). The shares of imports and exports of goods and services in GDP, respectively 49% and 55%, are in line with the OECD averages. Machinery and transport equipment is the main export sector, followed by chemicals and related products (including pharmaceuticals) and the food and live animal sectors. The main recipients of Danish products are Germany, Sweden and the United Kingdom (OECD, 2019[7]).

General government expenditure reached about 51% of GDP in 2017, the fourth highest share in the OECD after France, Finland and Belgium (OECD, 2019[9]). Social spending is among the highest in the OECD (OECD, 2018[10]). Danes enjoy working hours below the OECD average, and income inequality (as measured by the Gini coefficient) remains among the lowest in the OECD (OECD, 2019[11]; OECD, 2017[12]).

The employment rate was high at 74.2% in 2017, compared with the OECD average of 67.8%. Sustained employment growth in the private sector brought the unemployment rate down to 5.7% in 2017; the rate is expected to fall to 4.9% in 2020 (OECD, 2019[7]).

Figure 1.2. Services dominate the economy and agriculture's contribution to exports exceeds the OECD average



Source: OECD (2018), *OECD National Accounts Statistics* (database); OECD (2019), "Trade in value added", *OECD Statistics on Trade in Value Added*, (database).

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1.2.3. Population, well-being and quality of life

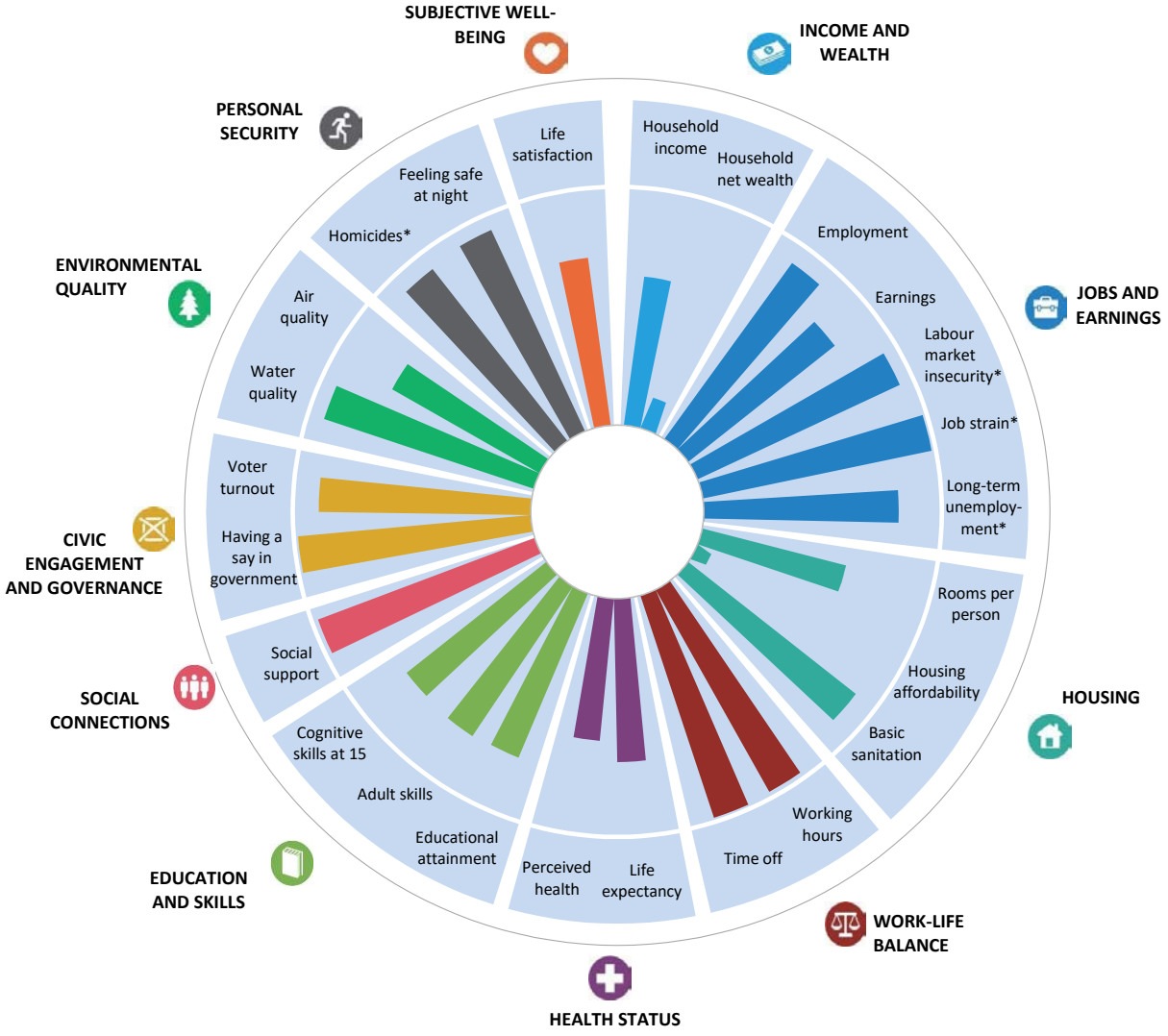
Over 2005-18, the population increased little but steadily from 5.4 million to almost 5.8 million (SD, 2018[13]). In 2015, there were on average 33 people of retirement age (aged 65 and over) per 100 working-age people (aged 20 to 64), compared to the OECD average of 28%. By 2050, the ratio is expected to reach 45% in Denmark (compared to 53% in the OECD), leading to increased public spending on health, long-term care and pensions (OECD, 2019[14]). Denmark is addressing this challenge in its pension system and public finances by, for instance, linking retirement age to life expectancy (OECD, 2019[7]).

The health care system is highly accessible (unmet need for medical care due to financial or geographic reasons is low) and appears to allocate and use its resources efficiently, e.g. reductions in the number of acute-care beds were offset by non-acute-care sectors (OECD/EOHSP, 2017[15]). Cancer is one of the biggest challenges. Denmark has the fourth highest mortality rate in the EU, with cancer accounting for 29% of all deaths among women and 32% among men in 2014 (OECD/EOHSP, 2017[15]).

Denmark is consistently among the top ten countries ranked in terms of happiness indicators, along with other Nordic countries (Finland, Iceland, Sweden and Norway) (Helliwell, Layard and Sachs, 2018[16]), and performs well in various dimensions of well-being (Figure 1.3) (OECD, 2017[17]).

Over 80% of the population consider themselves well informed on environmental issues. Danes are particularly concerned about air and water pollution, chemicals in everyday products, and water scarcity, but are less worried than people in many other EU countries about the growing amount of waste (EC, 2014[18]).

Figure 1.3. Denmark's average level of current well-being: Comparative strengths and weaknesses



Note: For both positive and negative indicators (such as homicides, marked with an "*"), longer bars always indicate better outcomes (i.e. higher well-being), whereas shorter bars always indicate worse outcomes (i.e. lower well-being). The indicator on income and wealth should be interpreted with caution as it excludes pension wealth.
Source: OECD calculations based on *OECD How's Life? 2017*.

1.3. Transition to an energy-efficient and low-carbon economy

1.3.1. Energy structure, intensity and use

Main policies and measures: Denmark is shifting from 2020 to 2030 goals

Denmark's energy policy is laid out in broad commitments called Energy Agreements, which are supported by various parties in the Parliament (Chapter 2, Box 2.2.). The 2012 Energy Agreement set the framework for 2012-20 and the 2018 Energy Agreement for 2020-24. Both support Denmark's long-term goal of becoming a carbon-neutral society by 2050, a goal first set in 2011 in the Energy Strategy 2050. Intermediate goals include reaching 30% of renewable energy resources in gross final energy consumption by 2020

(reached in 2016) and 55% by 2030. Denmark also committed to phase out electricity production from coal by 2030 (Table 1.1). The 2018 Energy Agreement is a key step for Denmark to meet its 2050 target. Prior to this, the Danish Energy Agency estimated that without additional policies, the share of renewables would stagnate and fossil fuel consumption and GHG emissions increase after 2020 (EA, 2017[19]).

Table 1.1. Medium- and long-term goals stated in the 2012 and 2018 Energy Agreements

	2020	2030	2050
Overall goal			Carbon-neutral society
Share of renewables in gross final energy consumption	30%	55%	
Renewables in electricity consumption		More than100% 90% share of district heating based on sources other than coal, oil or gas	
Renewables share in the transport sector	10%		
Wind energy share in domestic electricity supply	50%		
Reduction in gross energy consumption in relation to 2010	7.6%		
Coal in electricity production*		Phased out	

Note: 2020 goals taken from the 2012 Energy Agreement, 2030 goals from the 2018 Energy Agreement.
* The 2018 Energy Agreement notes the announcements made by energy companies in Denmark to phase out coal by 2030.
Source: (MCEB, 2012[20]; Government of Denmark et al., 2018[21]).

The 2018 Energy Agreement includes ten priorities, with several initiatives for each. The agreement largely builds on the 2017 recommendations made by an independent energy commission (DEnC, 2017[22]). It proposes, for instance, increasing flexibility of the energy system, removing restrictions on production in the form of combined heat and power (CHP) requirements, implementing market-based and technology neutral solutions, phasing out subsidies (except for existing CHP plants) and pursuing international co-operation. It has a strong focus on cost-effectiveness (OECD, 2019[7]). Under the agreement, technology-neutral one-off investment grants will replace feed-in tariffs in a move to solutions that are more responsive to changing market conditions. Some EUR 560 million is to be allocated for this purpose from the state budget for 2020-24 (Chapter 3).

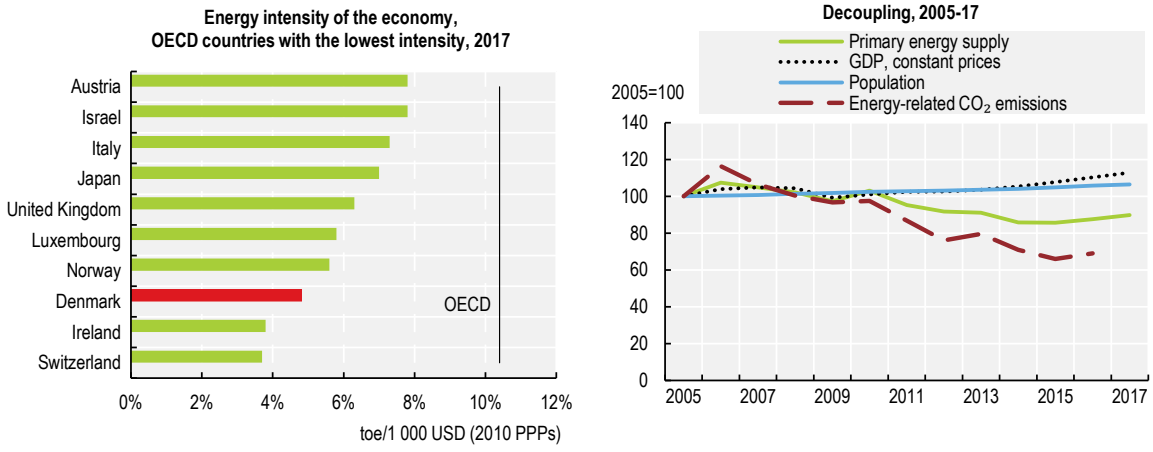
Implementing tools such as the policy, regulatory and analytical framework will complement the agreement to contextualise certain initiatives on renewables and energy efficiency, including the gas strategy, a new energy savings programme and the building renovation strategy. The EU will need to approve some initiatives under its state aid rules. A special reserve is planned under the agreement for additional actions as of 2025 (MCEB, 2012[20]; Government of Denmark et al., 2018[21]).

The 2018 Energy Agreement does not clarify how Denmark plans to cope with the energy need and associated environmental impact of data centres under construction, which will contribute to growing energy demand, while coal is to be phased out. It is estimated that their projected electricity consumption will account for 21% of total electricity consumption in 2030 and 35% in 2040 (EA, 2018[23]). Finally, the 2018 agreement reconfirms continued extensive oil and gas extraction in the North Sea, although Denmark also announced in 2018 that there would be no onshore oil, gas and shale gas exploration (Government of Denmark et al., 2018[21]).

Energy intensity is low

Denmark has decoupled energy use from GDP growth; the energy intensity of the economy has declined by 20% since 2005 and its level is among the lowest in the OECD (Figure 1.4).

Figure 1.4. Energy intensity is low and energy use has been decoupled from growth

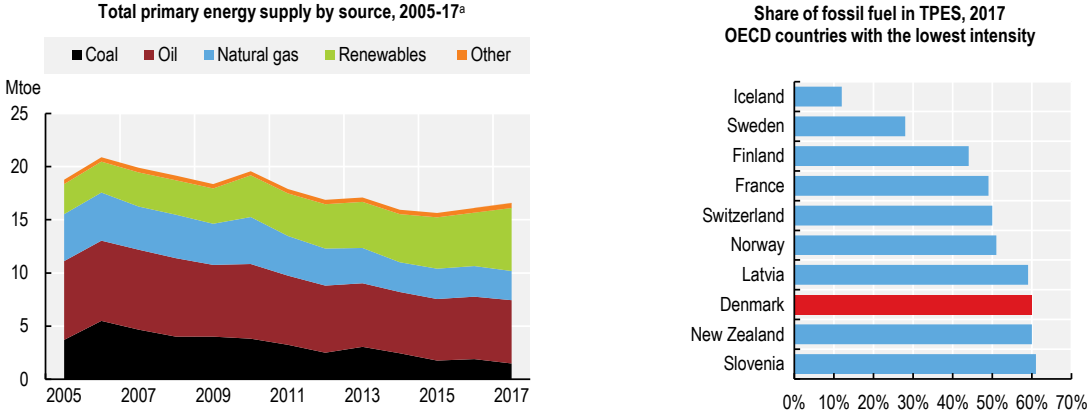


Source: IEA (2018), *IEA World Energy Statistics and Balances*, (database).

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Total primary energy supply (TPES) fell between 2010 and 2015, but slightly rebounded in 2016-17.[2] The contribution of fossil fuels to TPES dropped significantly, from 82% in 2005 to 60% in 2017. The share of renewables in TPES more than doubled over this period, from 15% to 35% (Figure 1.5).

Figure 1.5. The share of fossil fuels in energy supply has decreased significantly



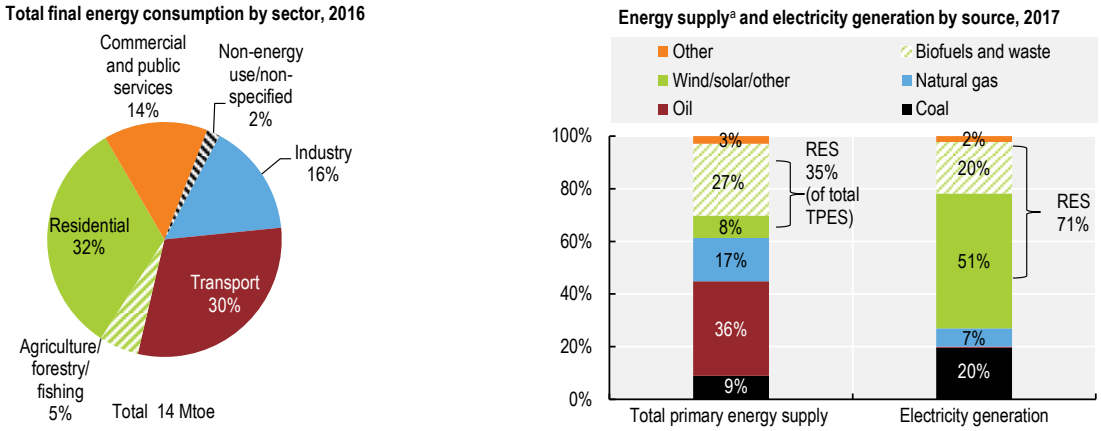
a) Total primary energy supply (TPES). The breakdown of TPES excludes electricity trade.
Source: IEA (2018), *IEA World Energy Statistics and Balances* (database).

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Total final consumption fell by 8% between 2005 and 2016. It decreased in all sectors except residential, where it remained relatively unchanged. The largest decline was in the industry sector (25%) (IEA, 2018[24]). The residential and transport sectors are generally

the largest energy consumers. Each accounted for about one-third of consumption in 2016, while the shares of the commercial and industrial sectors were around 15% each (Figure 1.6).

Figure 1.6. The residential and transport sectors continue to be the largest energy consumers, and renewables dominate in electricity generation



a) Total primary energy supply (TPES). The breakdown of TPES excludes electricity trade. RES = renewable energy sources.
Source: IEA (2018), *IEA World Energy Statistics and Balances* (database).

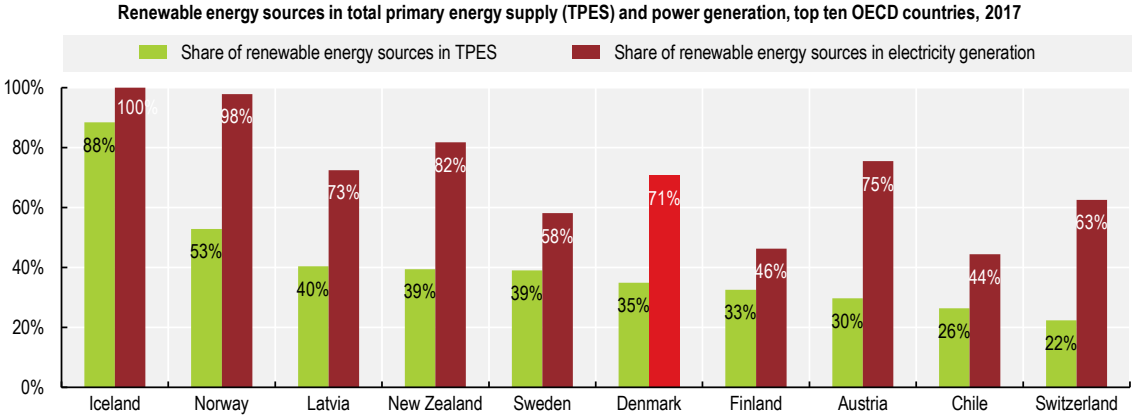
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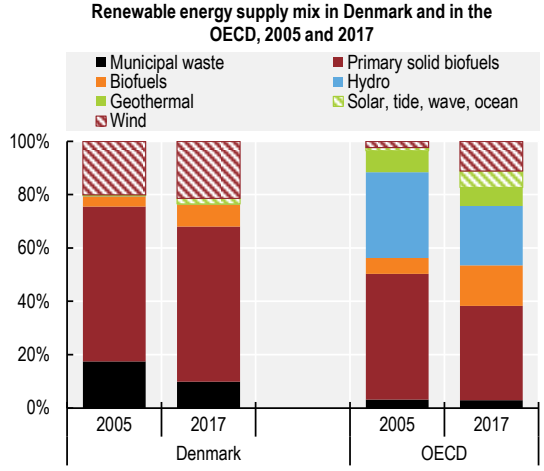
Denmark is a leader in integrating variable renewables

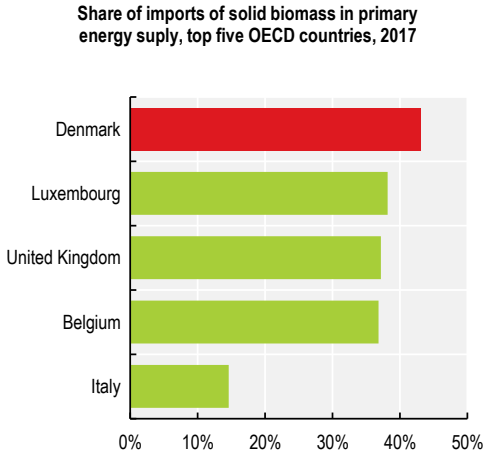
Denmark is one of the leading OECD countries in terms of the renewables share in TPES, despite not having hydropower potential comparable to other leading countries. Renewables (mainly biofuels, waste and wind) rose in significance in energy supply and power generation over the review period (Figure 1.7). The 2010-20 National Renewable Energy Action Plan, implementing the relevant EU directive, set a target of 30% of renewables in gross final consumption by 2020 (the sixth highest target in the EU). Sectoral targets complemented the national target: 39.8% for heating and cooling, 51.9% for electricity and 10.1% for transport in 2020 (MEC, 2010[25]; MCEB, 2012[20]). In 2018, the EU agreed that Denmark's binding renewables target for 2030 was 32%. All EU countries must prepare ten-year integrated national energy and climate plans with national targets, contributions, policies and measures by 31 December 2019 (European Parliament, 2018[26]).

Over 2005-17, Denmark more than doubled the share of renewables in TPES, from 15% to 35% (IEA, 2018[24]). It also met its target of 30% renewables in gross final energy consumption before the 2020 deadline, and is on track to meet its 50% target for wind energy in domestic electricity supply for 2020 and 90% for renewables in district heating by 2030 (EA, 2018[27]). Achieving the target of 10% renewable sources in transport fuels by 2020, as required by the EU Renewable Energy Directive, would require strengthening the biofuel blending mandate. Negotiations are taking place in Denmark on this issue, as relying on the 2018 Energy Agreement would lead to an 8.7% share (Climate Council, 2018[28]; Eurostat, 2019[29]; Denmark, 2019[30]).

Figure 1.7. Renewables, chiefly biofuels and wind, have been gaining significance in energy supply, particularly in power generation







Source: IEA (2018), *IEA World Energy Statistics and Balances* (database).

StatLink http://dx.doi.org/10.1787/888934001806

Electricity generation has changed fundamentally over the past two decades, with wind and bioenergy (Figure 1.7) having largely superseded coal. Supported by its flexible domestic power system and high level of interconnection, Denmark is now widely recognised as a global leader in integrating variable renewables in its electricity system while maintaining a highly reliable and secure power grid (IEA, 2017[1]). With the share of wind energy in the electricity supply at over 40% in 2017, Denmark is on the way to meeting its 2020 target of 50% of electricity from wind power, and is among the top five countries for wind in electricity generation (REN21, 2018[31]; IEA, 2018[24]).

Denmark imports over 40% of the solid biomass it uses for energy purposes, more than any other OECD country (Figure 1.7). The use of wood pellets increased by 187% between 2006 and 2016, and the share of imports was 94% in 2016 (Ea Energianalyse, 2017[32]). The dominant role of bioenergy in the renewables mix raises the issue of environmental sustainability of supply (OECD, 2019[33]), as only documented CO_2-neutral biomass should be counted as a renewable and favourable treatment should be ended (Chapter 3). In addition, increasing use of biomass in the heating sector contributes to emissions of air pollutants, including $PM_{2.5}$, polycyclic aromatic hydrocarbons (PAHs), black carbon and dioxins (IEA,

2017[1]; AU-DES, 2018[34]). To address such concerns, the Danish industry introduced voluntary sustainability criteria in 2014-15 (Brack, Hewitt and Marchand, 2018[35]).

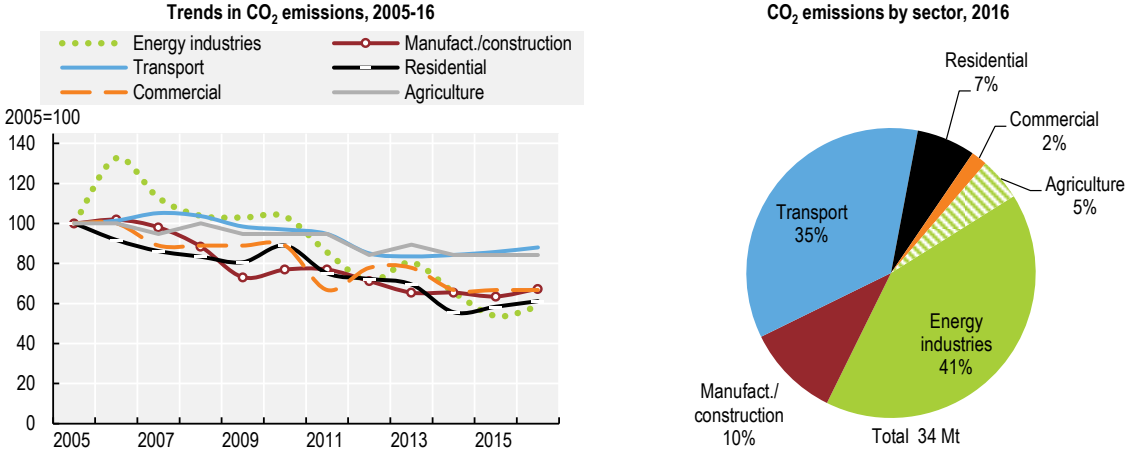
1.3.2. Transport

The transport sector is the second highest energy consumer (road transport accounts for about three-quarters of energy consumption in the sector) and GHG emitter. Despite well-developed infrastructure, Denmark has one of the lowest shares of rail in inland freight transport in the EU (Eurostat, 2018[36]; ITF, 2018[37]). In 2014, the main message on infrastructure of the Danish Productivity Commission was to expand user payments to reduce congestion (Productivity Commission, 2014[38]).

The number of passenger cars per inhabitant is still below the OECD average, but increased from 35 to 44 vehicles per 100 persons between 2005 and 2018. The share of diesel cars in the total passenger car fleet rose from 10% in 2005 to 31% in 2017 (RD, 2018[39]). The growth trend in the number of personal cars is expected to continue, in line with reductions in the existing heavy tax burden (e.g. registration tax) (Chapter 3).

Although energy-related CO_2 emissions in transport have declined over the last decade (Figure 1.8), the pace has been slower than in the energy sector. Denmark bases its climate policy on cost-effectiveness and impact on the competitiveness of the sectors. Reducing emissions in the energy sector, which is partly shielded from international competition, has proved to be the least costly solution. Fewer cost-effective options have been identified in transport and agriculture, as is the case for almost all OECD countries. By 2020, emissions in the sectors not covered by the EU Emissions Trading System (EU ETS), particularly transport, are expected to represent around 70% of overall GHG emissions (MEUC, 2017[40]). Moreover, before new initiatives were proposed under the 2018 Energy Agreement and the climate and air proposal (Section 1.3.3), the Danish government had projected that fossil fuels would still account for over 93% of transport-related energy consumption in 2030 (compared to 95% now). Decreased dependence on fossil fuels in the transport sector thus requires sustained efforts (EA, 2018[41]).

Figure 1.8. CO_2 emissions in transport are declining but still significant and the pace is slower than in other sectors



Note: CO_2 emissions from energy use only.
Source: IEA (2018), *IEA CO_2 Emissions from Fuel Combustion* (database).

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Zero-emission vehicles are considered to have great potential for supporting Denmark's goal of becoming a carbon-neutral society by 2050 (Sørensen et al., 2017[42]). The government's 2018 climate and air proposal is an important step in reaching this goal. It aims to halt sales of new diesel and gasoline vehicles by 2030 and hybrids by 2035. The proposal includes incentives for green vehicles, such as investment in high-speed charging stations for electric vehicles (EVs), tax incentives for green company cars (Chapter 3), cheaper car parks with priority for green vehicles, and permission for green vehicles to drive in bus lanes (Danish Government, 2018[43]). Electric and hybrid cars costing less than DKK 400 000 (EUR 54 000) are exempt from registration tax in 2019 and 2020 (MF, 2018[44]). The increase in Danish renewables production should support the spread of clean vehicles, although reaching 1 million EVs and plug-in hybrids by 2030 (a potential outcome of the incentives) may be costly (OECD, 2019[7]).

While electrification of the main Danish rail lines is ongoing, it has fallen behind execution of the 2014 Danish flagship project in the rail transport area, Train Fund DK, which has been limited from its original scope (MF, 2017[45]). The project aimed at upgrading the Danish railways by building new lines, upgrading existing lines and electrifying major lines (MTBH, 2014[46]) to reduce travel times and support environmental objectives, for instance by switching from diesel to electric trains.

1.3.3. Climate change mitigation and adaptation

Main policies and measures

Danish policy on climate comprises national goals and efforts combined with international and EU obligations. The main Danish policy documents making up the current framework include the 2008 Danish Strategy for Adaptation to a Changing Climate (an Action Plan for a Climate-proof Denmark followed in 2012), the 2012 Energy Agreement for 2012-20, the 2018 Energy Agreement for 2020-24 and the 2018 climate and air proposal. The Climate Act regulated the preparation of an annual government climate report to Parliament, outlined the process of setting national climate targets and established an independent, expert-based Climate Council (MEUC, 2017[40]), with six members appointed for four years by the relevant minister.

The government presented the climate and air proposal in October 2018, outlining measures to reduce GHG emissions and air pollutants in non-EU ETS sectors up to 2030, on the assumption that these closely linked issues needed synergistic measures. The proposal supports the 2050 goal of a carbon-neutral society and sets out 38 activities. It announced the phase-out of sales of new diesel and gasoline cars by 2030 and hybrids by 2035 (the aim is to have 1 million EVs and plug-in hybrids by 2030), as well as measures on the greening of public transport; environment-friendly shipping; agriculture (e.g. EUR 12 million for research and development [R&D] on low-GHG farming and EUR 14 million for carbon capture and storage [CCS] in Danish farmland and forests); and greener buildings and businesses (Danish Government, 2018[43]).

The government has completed or initiated implementation of the majority of initiatives proposed under the climate and air proposal (e.g. via the Finance Act for 2019). These include a larger premium for scrapping old diesel cars and grants for investment in low-carbon technology regarding barns or CCS research (Denmark, 2019[30]). Transforming the proposal into actions in agriculture and transport, which is key for Danish non-EU ETS reduction commitments, is under way (e.g. a consultative committee was established in February 2019). The OECD recommended that Denmark first implement the most

cost-effective emission reduction measures, in agriculture (OECD, 2019[7]). The country should benefit from securing a broad political commitment for its climate and air initiatives.

During the review period, Denmark's climate policy focused on meeting international GHG emission reduction targets in the first (2008-12) and second (2013-20) Kyoto commitment periods. The country met its commitment in the first commitment period and announced in 2015 that it would cancel its surplus Kyoto Protocol units[3] to support the Paris Agreement negotiating process (Government of Sweden, 2015[47]). In 2016, Denmark ratified the Paris Agreement, which replaces the Kyoto Protocol.

In 2014, the EU adopted a climate and energy framework committing members to achieve, among other targets, a 40% reduction in GHG emissions, by 2030, from 1990 base levels – 43% for EU ETS sectors and 30% for non-ETS sectors. Emissions from EU ETS sectors are adjusted at the EU level via a quota system, so Denmark has no specific national target. For non-ETS sectors, Denmark defines and implements national policies and measures. In 2009, the EU adopted what is known as the effort-sharing decision, establishing binding annual GHG emission targets for 2013–20. Denmark agreed to reach a 20% reduction from 2005 levels (the biggest commitment among EU members, with Ireland and Luxembourg) and is on track to meet it. In the 2018 EU Effort Sharing Regulation, Denmark again agreed one of the most ambitious reduction targets in the EU for 2030: 39% below 2005 levels (MEUC, 2018[48]; EC[49]). This will require further mitigation efforts, and Denmark plans to take stock of its climate and air initiatives in 2022, 2024 and 2027.

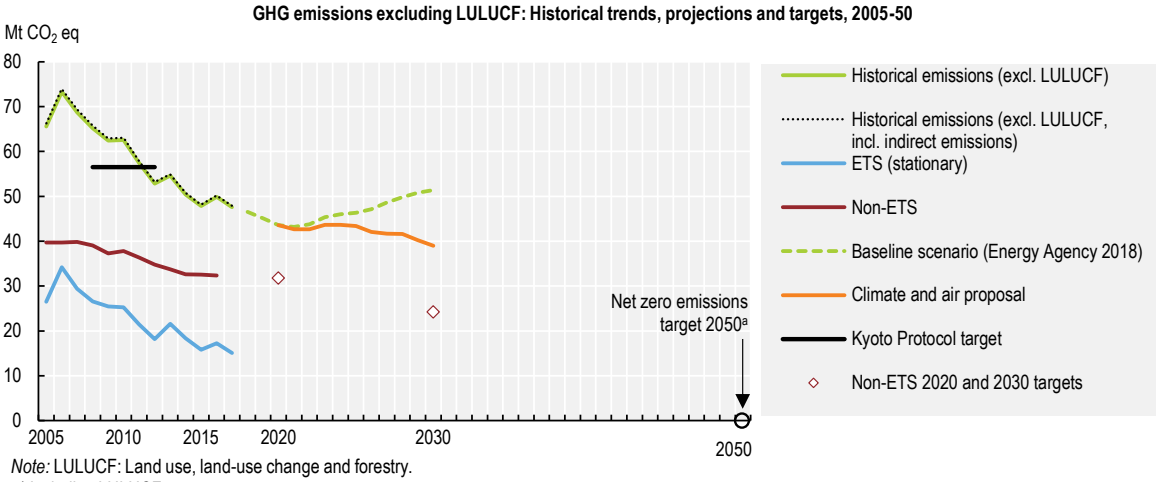
Non-EU ETS emissions are expected to account for about 70% of all GHG emissions by 2020. As allowed by the effort-sharing policy, and considering cost-effectiveness, Denmark has chosen to make significant use of flexibility mechanisms to achieve around 80% of the expected GHG emission reductions up to 2030 (about 21 million tonnes of carbon dioxide equivalent or Mt CO_2eq). Two-thirds of it will be achieved through land use, land-use change and forestry (LULUCF) credits and one-third through cancellation of EU ETS quotas (Danish Government, 2018[43]). This approach triggered concerns among some Danish stakeholders that it did not support the 2050 carbon-neutrality target (Climate Council, 2018[28]). The 2018 Energy Agreement envisions reductions of 10-11 Mt CO_2eq, mainly in EU ETS sectors (MEUC, 2018[50]).

GHG emissions have declined significantly

Having reduced its GHG emission levels by 27.7% over 2005-17 (Figure 1.9), Denmark is at the forefront of OECD countries in this regard. It is one of the few OECD countries that achieved absolute decoupling of both production-based and demand-based CO_2 emissions from real GDP. The GHG emission intensity per unit of GDP is also below the OECD average (OECD, 2018[51]; IEA, 2019[52]; OECD, 2017[53]). Emissions rose in 2016, particularly in the energy and industry sectors, due to increased economic activity and climate conditions (SD, 2018[54]), but they fell again in 2017, mainly due to a significant increase in renewables (Denmark, 2019[30]).

GHG emissions in EU ETS sectors decreased significantly over 2005-17 (e.g. emissions from stationary installations fell by 43%, well above the EU average of 14%) (EEA, 2018[55]). The decline was driven by a proactive policy to support diffusion of renewables, partly financed by an additional tax on electricity consumption (the Public Service Obligation, Chapter 3). GHG emissions fell more slowly in non-EU ETS sectors, where solutions are less available and more costly, declining by 18% over 2005-17 (Eurostat, 2019[56]).

Figure 1.9. Stronger measures to reduce GHG emissions will be needed for Denmark to meet its long-term goal



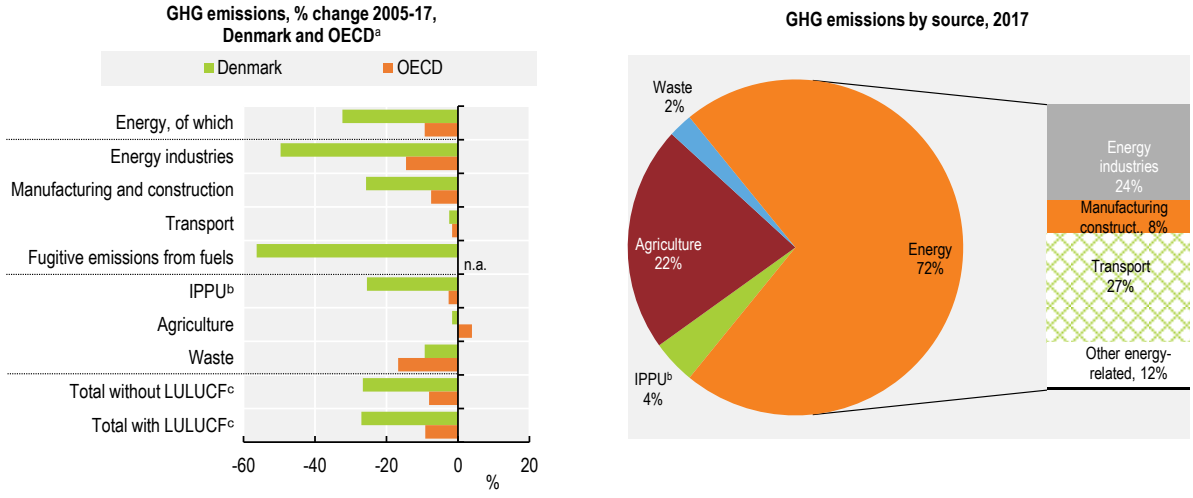
Note: LULUCF: Land use, land-use change and forestry.
a) Including LULUCF.
Source: Nielsen et al. (2019), *Denmark's National Inventory Report 2019*; Danish Centre for Environment and Energy (2018), *Projections of Greenhouse Gases 2017-2040;* EEA (2018), *GHG Data Viewer* (database).

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Danish forests remained carbon sinks during the review period. The carbon stock increased over 2005-17 in both live and dead forest biomass, litter and soil (Nord-Larsen et al., 2018[57]). Cropland and grasslands, on the other hand, are net carbon sources, partly because of the large area of organic soil (peatland) drained (Nielsen et al., 2018[58]).

The energy sector is the largest source of GHG emissions, at over 70%, but is also the one that has seen the most notable reduction, by over 30% between 2000 and 2017 (Figure 1.10). The decrease is mainly linked to the shift from coal to natural gas and renewables, and has mostly occurred since 2010, while for other emission sources (agriculture, industry and waste), emissions are virtually unchanged since 2010 (Nielsen et al., 2018[58]).

Figure 1.10. GHG emissions declined more than the OECD average



Note: Data for Denmark include Greenland and Faroe Islands.
a) Data for OECD refer to 2005-16.
b) Industrial processes and product use.
c) Land use, land-use change and forestry.
Source: Nielsen et al. (2019), *Denmark's National Inventory Report 2019;* OECD (2018), "Air and climate: Greenhouse gas emissions by source", *OECD Environment Statistics* (database).

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As in most countries, CO_2 accounts for the bulk of total GHG emissions (over 70% in 2016), while methane and nitrous oxide (N_2O) from agriculture accounted for about 20%, excluding LULUCF. Agricultural GHG emissions declined by 17% over 1990-2016, but since 2005 have fallen only modestly, by 3%. The reduction in methane emissions since 1990 is attributable mostly to increased use of incineration instead of other waste disposal, as methane emissions from agriculture did not change over the period. The reduction in N_2O emissions is related to a considerable decline in the use of nitrogen fertilisers, but the level of emissions since 2010 has barely changed (Nielsen et al., 2018[58]).

Climate change poses challenges

In addition to rising temperatures, climate change is likely to bring Denmark increased precipitation, especially in winter. Over the long term, rising sea and groundwater levels will be of concern. One of the most significant challenges is increased frequency, intensity and duration of extreme weather events. In fact, Denmark was more affected than any other EU country in terms of direct economic losses per capita from weather disasters over 1980-2016 (EEA, 2018[59]). The value of assets at risk of flooding is expected to grow significantly due to sea level rise and increased precipitation (OECD, forthcoming[60]).

The 2008 Danish Strategy for Adaptation to a Changing Climate focuses on targeting information, co-ordinating research strategy (e.g. through the Forskernetværk for Klimatilpasning or Climate Adaptation Research Network) and supporting co-ordinated efforts by public authorities (Danish Government, 2008[61]). The Action Plan for a Climate-proof Denmark followed in 2012, mostly focusing on enhancing state and municipal interactions (Danish Government, 2012[62]). Between 2012 and 2017, the government supported the preparation and evaluation of the climate change adaptation

plans adopted by each municipality and elaborated cost-effective and comprehensive flood and erosion protection (MEUC, 2017[40]).

1.3.4. Atmospheric emissions and air quality

Main policies and measures

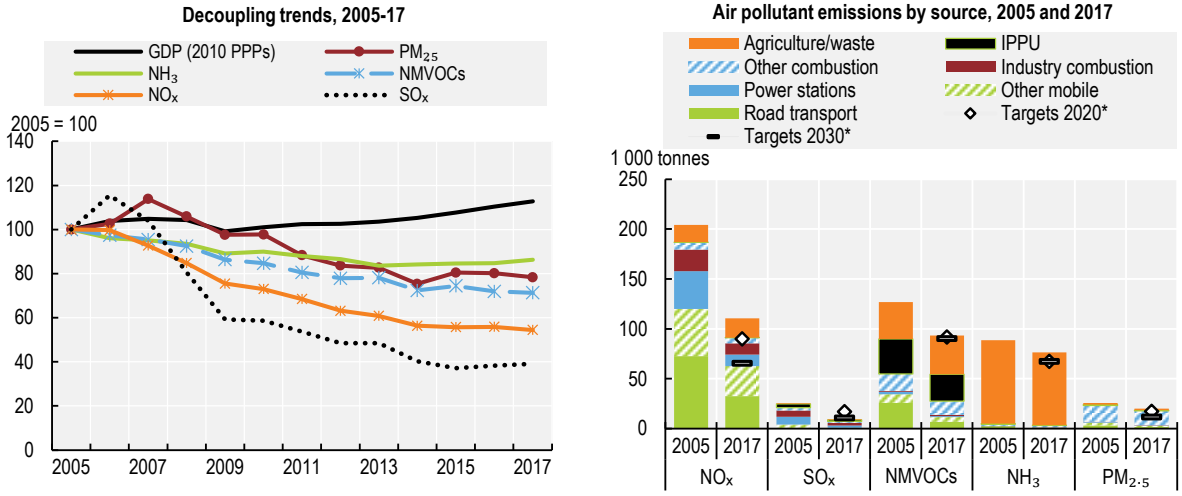
The 2016 EU National Emission Ceilings (NEC) Directive (replacing the 2001 directive establishing emission ceilings for 2010) addresses the 2020 targets agreed under the Gothenburg Protocol to the Convention on Long-Range Transboundary Air Pollution (CLRTAP) and sets objectives for 2030 (EC, 2016[63]). It establishes national emission reduction commitments applicable from 2020 and stricter targets as of 2030 for nitrogen oxides (NO_X), non-methane volatile organic compounds (NMVOCs), sulphur dioxide (SO_2), ammonia (NH_3) and $PM_{2.5}$ (EC, 2018[64]). The National Air Pollution Control Programme, an implementation measure supporting compliance with the NEC Directive, was announced by the government in January 2019 and submitted to the European Commission for approval in April. It is based on initiatives from the 2018 climate and air proposal (MEF, 2019[65]). For instance, for NH_3 emissions it includes public financial support for low-emission barns and regulation of urea-based chemical fertilisers. Other domestic measures to help improve air quality include a ban on manure application by splash plate and a requirement to roof slurry tanks. Measures to reduce $PM_{2.5}$ focus on cleaner transport and accelerated replacement of old residential wood stoves.

Other means of addressing air quality in Denmark include national air quality monitoring (AU-DES, 2018[66]) and adherence to relevant multilateral environmental agreements. Denmark uses economic instruments to reduce emissions (e.g. a NO_X tax), and since 2008 has applied emission standards to residential wood-burning stoves as well as supporting international work in this area. It lobbied for stricter requirements on sulphur content of ship fuel and reductions in NO_X emissions from new ships. The Baltic Sea and North Sea are now International Maritime Organization Emission Control Areas[4] for SO_X (IMO[67]) and will become NO_X emission control areas in 2021. The 2019 budget includes a scrap premium for old wood stoves (MF, 2018[44]). In addition, improved inventories of wood-burning stoves will further support targeted reduction measures.

Air emissions have decreased but the outlook on 2030 targets is unclear

The main sources of air pollution are agriculture (NH_3, NMVOCs), motorised transport (NO_X), wood combustion ($PM_{2.5}$, PAHs) and industry (SO_X) (Figure 1.11). With reductions in all emissions of major air pollutants in recent decades, Denmark has decoupled emissions from economic growth – most impressively in the case of SO_2, emissions, which fell by 61% over 2005-16. However, by 2014 the reduction trend for air pollutants had slowed or even reversed, due chiefly to increased economic activity.

Figure 1.11. Air emissions have been on the decline but this trend has slowed



Note: EMEP data reported under the Convention on Long-Range Transboundary Air Pollution.
* Emissions Reduction Commitments under the NEC Directive (final agreement, 30 June 2016).
Source: EMEP (2019), *WebDab* (database); OECD (2018), *OECD National Account Statistics* (database).

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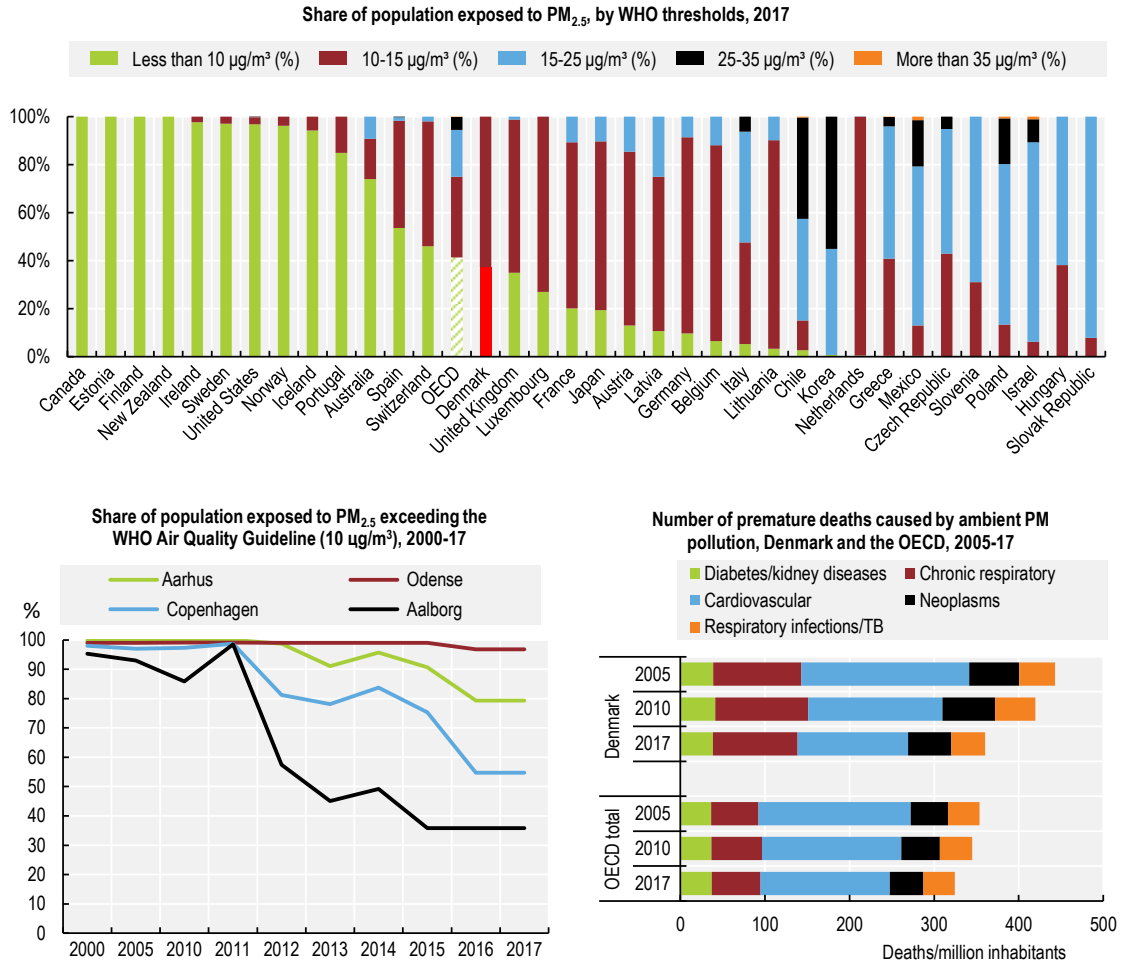
Denmark met its 2010 targets under the old NEC Directive by 2016. Its SO_2 reductions also exceeded the 2020 reduction commitment of 35% under CLRTAP, the revised EU NEC Directive and even the 2030 target. Denmark is on track to meet its 2020 targets under the new NEC Directive for NO_X (56%) and NMVOCs (35%) (AU-DES, 2018[68]). However, it will be more difficult for Denmark to meet its NEC commitments for 2020 and 2030 on fine particles ($PM_{2.5}$, 33% and 55%, respectively) and NH_3 (24%), despite the reductions thus far (MEF, 2019[65]). In line with the 2018 climate and air proposal, a committee will be set up to propose possible actions to reach the NH_3 target (unchanged between 2020 and 2030) and initiatives have been launched to accelerate replacement of old wood-burning stoves, which would reduce $PM_{2.5}$ emissions (Danish Government, 2018[43]).

Denmark also needs to address potentially carcinogenic PAH emissions, which grew by 58% between 1990 and 2016. The bulk of PAHs (68%) in 2016 came from residential wood burning (AU-DES, 2018[69]). Rising residential burning also contributes to $PM_{2.5}$ and NMVOC emissions. The actions taken to reduce $PM_{2.5}$ emissions from wood burning will also help target PAH emissions.

Air quality is a recurring issue

Air quality remains a challenge (Figure 1.12). Danish estimates indicate that ambient air pollution contributed to 3 200 premature deaths, on average, over 2014-17, though the number is on the decline. Some 90% of cases were related to exposure to $PM_{2.5}$ (Ellermann et al., 2018[70]). The welfare costs related to $PM_{2.5}$ exposure are estimated at 3% of GDP (OECD, 2018[71]).

Figure 1.12. Air quality remains a challenge



Source: OECD (2018), "Exposure to air pollution", *OECD Environment Statistics* (database).

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1.3.5. Chemicals management

Denmark has a comprehensive regulatory framework for chemicals management, with national rules that sometimes go beyond the scope of the EU acquis. There is good co-operation between government, industry and other stakeholders. Public health and environmental protection issues are at the heart of Denmark's chemicals management policy, which pays particular attention to substitution of hazardous chemicals and the safety of chemicals in consumer products. A challenge is to strike the right balance between the resources used for predictive risk assessment and the various risk-based monitoring exercises. If Denmark put more emphasis on identifying problematic chemicals and regulating them before a negative impact can be detected in humans or the environment, it would avoid having to deal with the risks they pose to nature and humans (Chapter 5).

1.3.6. Waste, materials management and circular economy

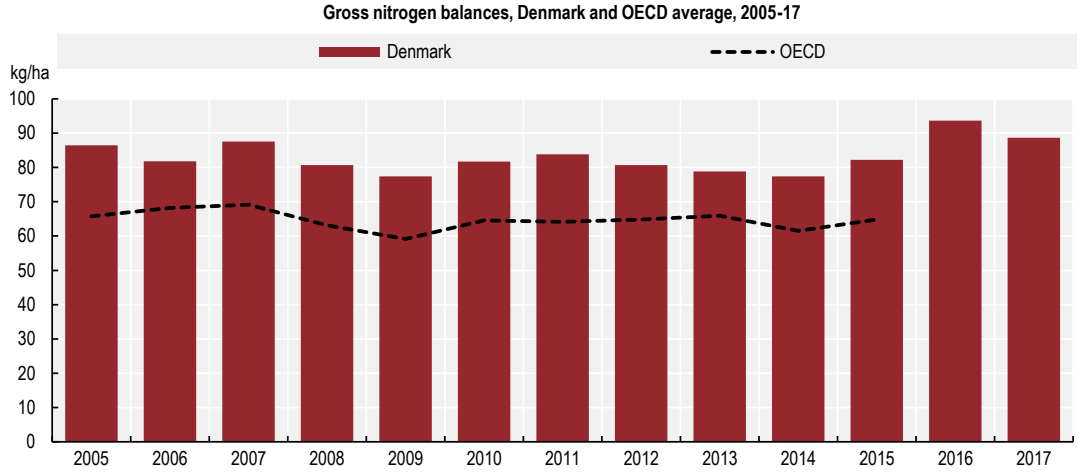
The Danish economy uses a large amount of raw materials per unit of GDP, which translates into low resource productivity. Denmark has become more efficient in the use of materials, but not enough to achieve the average performance of OECD countries. In 2016, resource productivity reached USD 1.95 per kg in Denmark, compared with USD 2.42 per kg in OECD countries (Chapter 4). In 2017, domestic consumption of materials per capita was about 24 tonnes, well above the OECD average of 16 tonnes per capita. About half of domestic material consumption is related to the construction sector (stone, gravel and sand extraction).

Waste generation as a whole increased by 30% between 2010 and 2016, to some 20 million tonnes. This increase was related to growth in construction and demolition waste, which accounted for more than 60% of the waste produced in 2016. Municipal waste generation also increased, by 12% between 2005 and 2016, faster than private final consumption. Landfilling has almost disappeared (it amounted to 1% of municipal waste in 2016) and Denmark has very high levels of recycling. Waste from industry, construction and demolition, packaging, electrical and electronic equipment and end-of-life vehicles is recycled at rates ranging from 70% to 90%. About half of municipal waste is not recycled, however, and feeds incinerators for energy recovery (Chapter 4).

1.3.7. Agricultural inputs and nitrogen balance

The coherence of agricultural and environmental policies needs special attention in view of the high rate of land use by agriculture (Section 1.5.1). The share of agriculture, forestry and fishing in GDP was halved over 2000-17, from 2.5% to 1.3%. Yet the agriculture and agri-food sector still accounted for 25% of Danish goods exports in 2015. The national balance of nitrogen in agriculture places Denmark above the OECD average (Figure 1.13). The nitrogen surplus has fluctuated between 77 and 94 kg N/ha since 2005 and remains a source of concern for nitrate pollution of coastal areas (OECD, 2018[72]).

Figure 1.13. The surplus of agricultural nitrogen remains a source of concern



Note: Gross nitrogen balances are calculated as the difference between the total quantity of nutrient inputs entering an agricultural system (mainly fertiliser and manure) and the quantity of nutrient outputs leaving the system (mainly uptake of nutrients by crops and grasses). They are expressed in tonnes of nutrient surplus or deficit. This calculation can be used as a proxy for the status of environmental pressures, such as declining soil fertility in the case of a nutrient deficit or, for a nutrient surplus, the risk of polluting soil, water and air. OECD values are simple averages of the nitrogen balances of OECD countries for which data are available.
Source: Blicher-Mathiesen et al. (2019), *Landovervågningsoplande 2017: NOVANA* (Agricultural watersheds 2017); OECD (2019), "Environmental performance of agriculture indicators", *OECD Agriculture Statistics* (database).

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Main policies and measures

The EU Common Agricultural Policy (CAP) for 2014-20 is the backbone of Denmark's agri-environmental policy. In particular, the CAP Rural Development Programme (RDP) supported a former goal of doubling the area under organic farming from 150 000 ha in 2007 to 300 000 ha in 2020. Nearly 280 000 ha, or 10.5% of the agricultural area, was already under organic farming by mid-2018 (Danish Agricultural Agency, 2019[73]). Beyond the public financial support provided under the RDP, increased consumer demand for organic products is a key factor in the growth of organic farming. In 2017, Denmark had the world's largest market share of organic products: 13.3% of the total food market (Willer and Lernoud, 2019[74]). The RDP also includes funds for 1 000 mini-wetlands to remove nutrients from drain water at the farm level; 7 500 ha of new forests; and R&D projects to reduce GHG emissions from agriculture (EC, 2017[75]).

A Food and Agriculture Package adopted in 2015 put in place "targeted regulation" of agricultural practices reflecting the risk of nitrate pollution of coastal waters. The aim is to improve cost-effectiveness by focusing nitrate reduction efforts on watersheds flowing into coastal waters threatened with eutrophication, giving farmers in other watersheds the opportunity to fertilise to the economic optimum. Before the regulation went into force, all farmers had to fertilise about 20% below the economic optimum (EPA, 2017[76]).

The agriculture sector moderately reduced its GHG emissions between 2005 and 2016, while the OECD average increased (Figure 1.10). Efforts are still needed to reach Denmark's carbon neutrality target of 2050. To this end, R&D programmes have been launched under the climate and air proposal covering non-EU ETS emissions. The goal is to identify relevant agricultural practices and incentives for them by 2030.

The use of biogas from manure can support climate and pollution goals. For example, using manure as a raw material for biogas instead of spreading it as fertiliser reduces the risk of air pollution (NH_3) and water pollution (nitrates), and digested manure provides a high-quality natural fertiliser that emits less N_2O than untreated manure. The 2018 Energy Agreement includes provisions to expand the use of biogas and other green gases, for instance in transport and industrial processes. A gas strategy is to be developed, focusing on using the Danish gas infrastructure and examining framework conditions for a competitive expansion of biogas and other green gases. The 2018 climate and air proposal also contains related measures, e.g. on detecting and reducing leaks from existing biogas plants (Government of Denmark et al., 2018[21]; Danish Government, 2018[43]).

1.4. Managing the natural asset base

1.4.1. Physical context

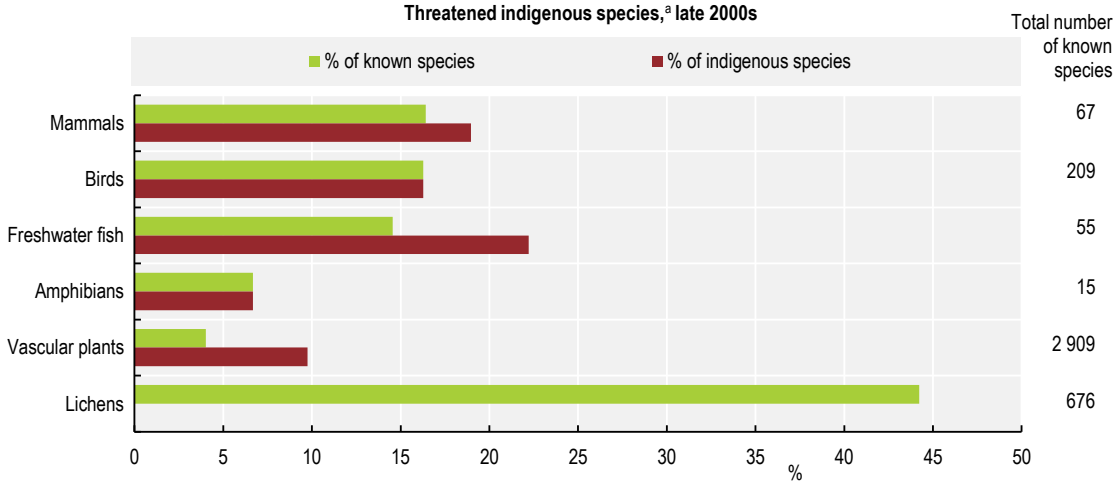
Croplands cover some 60% of Denmark's area, forests 13%, light-open habitats such as heath, dunes, meadows and marshes 9%, and artificial surfaces (urbanised areas) and inland waters the remaining 18% (SD, 2017[77]). The high proportion of croplands underlines the importance of ensuring coherence of agricultural policies with protection of the environment, and the 22% coverage of forests and light-open habitats indicates a need for promoting management of their ecosystem services.

1.4.2. Biodiversity and ecosystems

Some 30 000 species of plants, animals and fungi can be found in Denmark. About 15% of mammal, bird and freshwater species are threatened (Figure 1.14). In 2012, about 40% of

the animal species covered by the EU Habitats Directive had "unfavourable" status, compared with the EU average of 60% (Danish Government, 2014[78]). More than half the species on the red list (54%) depend on forest habitats for survival (NA, 2014[79]). Half the lichen species are threatened, reflecting high nitrogen deposition (NH_3 and NO_X).

Figure 1.14. Some 15% of mammal, bird and fish species are threatened



a) Threatened refers to the sum of "endangered", "critically endangered" and "vulnerable" species, i.e. species that are at greatest risk of extinction.
Source: OECD (2018), "Threatened species", *OECD Environment Statistics* (database).

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Main policies and measures

The Nature Protection Act (2013) has three objectives: to protect nature, restore or create areas of interest for wildlife and landscapes, and give the public access to nature. It implements the EU directives on birds and habitats. The National Strategy for Biodiversity 2014-20, also known as Danish Nature Policy (Naturplan Danmark), aims at improving connectivity of natural habitats, strengthening wildlife protection initiatives and developing a sense of community through outdoor activities in nature. It does not, however, include targets for protected areas. The 2016-19 Nature Package outlines plans to increase the area of "biodiversity forests" from 11 700 ha in 2016 to up to 28 300 ha in 2066, mainly in state-owned forests. By January 2019, 22 800 ha of such forests had been designated in state-owned forests; designation of other forest areas will be gradual over the next 50 years. Biodiversity forests have a more stringent biodiversity protection objective than other forests and less intensive or no management.

Amendments to the Planning Act in 2015 and 2017 introduced a requirement for municipalities to plan and designate existing and potential areas of special nature protection interest and wildlife corridors for a Green Map of Denmark (including existing Natura 2000 sites). The Green Map will reinforce efforts to establish larger and more interconnected areas of special nature protection interest. The map is gradually being developed as municipalities revise their land-use plans (Chapter 2). The Danish Environmental Protection Agency has developed a planning tool to help municipalities locate threatened species, habitats of high natural value and potential forest habitats for inclusion on the Green Map. Once the designation process is complete, the Green Map will provide a more accurate picture of the extent and location of existing and potential areas of particular

interest for nature conservation; it will indicate where to improve the quality of existing natural areas, and where to create new ones and corridors to link them (Danish Government, 2014[78]; MEF, 2019[80]; MEF, 2019[81]).

The vast majority of light-open habitats (those with no or only limited tree cover, such as meadows, heathlands, bogs and dry grasslands) and most freshwater lakes (totalling about 10% of the country's area) are included in Section 3 of the Nature Protection Act (Levin, 2016[82]). This gives them general protection. As a general rule, all activities that could have a direct negative impact on the integrity of habitats covered by Section 3 are prohibited. This includes, for example, the use of fertilisers, pesticides and cultivation. Only ancestral extensive farming practices can be maintained. The area of Section 3 habitats increased by 9% over 2006-16 (Levin, 2016[82]).

The Ministry of Environment and Food (MEF) estimated in April 2019 that 15% of Danish terrestrial habitats and inland waters were protected by law (Table 1.2). This is close to the global Aichi target of the Convention on Biological Diversity (CBD) to protect at least 17% of terrestrial habitats by 2020. In addition to the habitats in Section 3, terrestrial protected areas in Denmark include Natura 2000 sites and "conservation areas" (Table 1.2).

Table 1.2. Terrestrial protected areas of Denmark

2019[a]

Protected area type	Area (ha)	% of territory
Natura 2000 site[b]	366 380	8.5
Protected habitat according to Section 3	445 760	10.4
Conservation area[c]	114 028	2.7
Total protected area (without overlap)[d]	644 172	15.0

a) According to an analysis conducted by MEF in the second quarter of 2019.
b) Based on updated data on Natura 2000 sites (after boundary revision).
c) Protected area in accordance with Section 33 of the Nature Protection Act; based on data revised by an IUCN expert group in 2018 and reported to the European Environment Agency as part of the 2019 CDDA reporting.
d) The total area of Denmark used in the analysis is 4 305 175 ha.
Source: Country submission.

However, since most Danish protected areas have not been classified according to the different protection categories defined by the International Union for Conservation of Nature (IUCN), it is difficult to assess their degree of protection. To assign a protected area to an IUCN category, the area must be managed. Privately owned areas protected under Section 3 of the Nature Protection Act are not subject to statutory management requirements. There is no information at the national level on the extent of management in these areas, although this does not mean they are not managed. The Danish system of nature conservation consists of both designated protected areas, including Natura 2000 sites, and generally protected habitats. Only protected areas in accordance with Section 33 of the Nature Protection Act have been classified into IUCN categories.

Danish reporting to the IUCN World Database on Protected Areas (WDPA) overestimated the coverage of terrestrial protected areas. In particular, an IUCN expert group in 2018 found that the total number of protected areas regulated by specific conservation orders (within the meaning of Section 33 of the Nature Protection Act) was about 400, not 1 843 as previously reported to the WDPA (Woollhead and Petersen, n.d.[83]; MEF, 2019[80]). The

Danish Nature Agency has undertaken a more rigorous calculation of the extent and type of terrestrial protected areas.

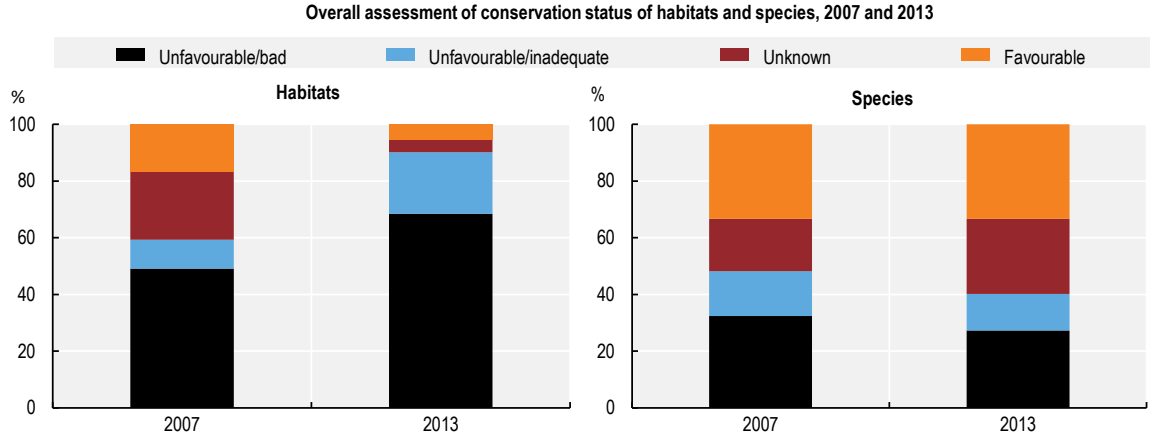
Until 2008, Denmark did not have national parks. It has since designated five national parks, the latest in 2018. Entrance is free. In general, the same rules apply inside and outside the parks, which are not fenced. However, in most national parks, specific planning zones impose restrictions on specific activities. The National Parks Act stipulates ten non-prioritised objectives. Each national park is established by an executive order in which the declared objectives appear. Each park is managed in a decentralised manner, with a board, a council and a secretariat. The board and its chair are appointed by the environment minister. The board prepares a plan for the operation and development of the park. The local community is invited to participate in this process. The development of national parks takes several years and is based on voluntary agreements with private landowners and local support. Whenever possible, board members have close ties to the national park area.

The 257 Natura 2000 sites cover 366 000 ha or 8.5% of Denmark's land area, the lowest share in the EU (EC, 2018[84]). They include 124 Special Protection Areas (SPAs) under the Birds Directive and 269 Special Areas of Conservation (SACs) under the Habitats Directive; 86 Natura 2000 sites overlap SPAs and SACs. The European Commission is to decide on revised coverage of Natura 2000 sites (Table 1.2) by the end of 2019 (Denmark, 2019[30]).

The first phase of Natura 2000 plans covered 2009-15 and the second phase covers 2016-21. Prior to launch, plans are subject to a three-month public consultation exercise. DKK 2 billion (EUR 270 million) has been allocated for implementation of the 2016-21 plans, partly from the RDP. These plans must be followed by local action plans developed by municipalities and owners of state land. Many Natura 2000 sites overlap with other forms of nature conservation.

The latest assessment of the state of conservation of Natura 2000 sites, published in 2014, revealed that in 2013, almost 70% of habitats had unfavourable or bad status, compared with the EU average of 30% (Figure 1.16). Surprisingly, only 27% of species covered by the Habitats Directive had unfavourable or bad conservation status (Figure 1.16), which would seem to indicate the important role played by other forms of nature conservation (Table 1.2).

Figure 1.15. The state of natural habitats in Denmark remains poor



Source: EC (2014), National Summary for Article 17 of the Habitats Directive, Report 2007-12.

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A new National Forest Programme (NFP) was adopted in 2018. It builds on the two long-term objectives of the previous NFP of 2002: i) increase forest cover so that the forest landscape covers 20% to 25% of the land area by the end of the century (compared to 13% now) and ii) ensure that by 2040, at least 10% of the Danish forest cover has biological diversity as its main management objective (MEF, 2018[85]). Expansion of "biodiversity forests" is thus linked, within the framework of the NFP, to extension of the total forest area. Steps are needed to accelerate the pace of afforestation and achieve the long-term objectives of the NFP, as forest area has increased only slightly since 2005 (Nord-Larsen et al., 2017[86]). A report from 2016 estimates that at least 75 000 ha of "biodiversity forest" is needed to stop the decline in biodiversity (Petersen et al., 2016[87]).

Marine protected areas (MPAs) cover 15% (881 325 ha) of the Danish North Sea area, including Skagerrak, and 3% (35 300 ha) of the Danish Baltic Sea area. Lack of data limits analysis of MPA network coherence in these two marine areas (Edelvang K. et al., 2017[88]). Other MPAs have been proposed, covering 4% (65 000 ha) of the Danish part of Kattegat (NA, 2015[89]). No designation of MPAs in the Belt Sea or the Øresund is envisaged. The North Sea area MPAs by themselves meet the Aichi target of protecting at least 10% of coastal and marine areas by 2020.

Denmark submitted its sixth report to the CBD in 2019. It states that ambitious new goals for nature should guide the development of a new National Strategy for Biodiversity (MEF, 2019[81]).

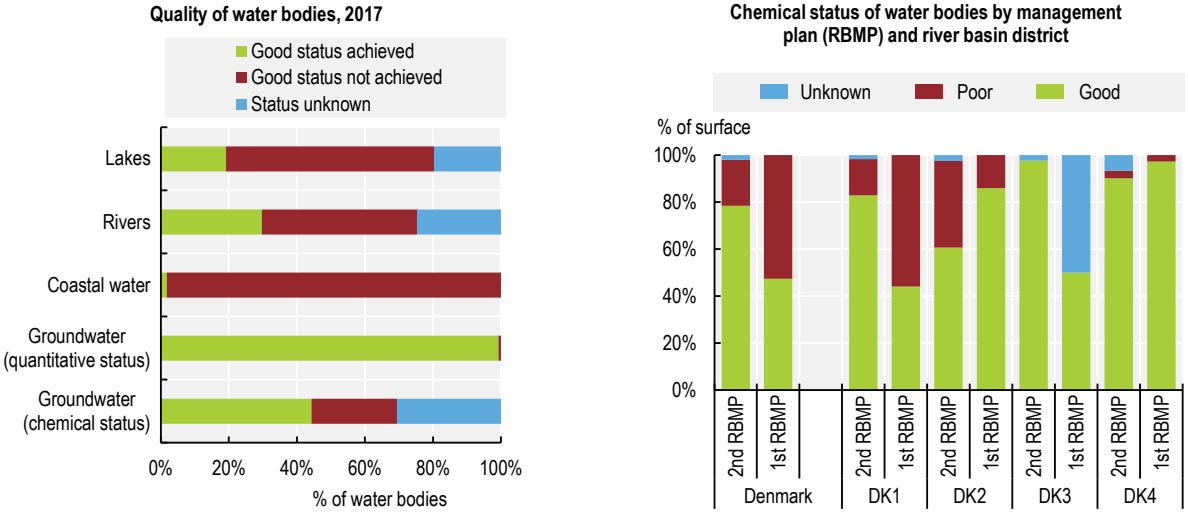
1.4.3. Management of coastal waters and freshwater

Denmark has many coasts and fjords and uses chemically untreated groundwater for the production of drinking water (OECD, 2017[90]). At the same time, it has the largest proportion of cultivated land among OECD countries, with the associated risk of nutrient and pesticide pollution. Until 2009, three Aquatic Action Plans targeted the leaching of nitrogen from the root zone. Since then, Denmark has sought instead to reduce the nitrogen load in coastal waters, irrespective of the pathway (leaching or run-off) (MEF, 2017[91]).

Water quality

The ecological status of lakes, rivers and groundwater has improved in eastern Denmark (OECD, 2018[92]), but problems remain in meeting the requirements of the EU Water Framework Directive (WFD). Measures taken under Aquatic Action Plan III (2005-09) and River Basin Management Plan (RBMP) 2009-15 helped reduce the agricultural nitrogen surplus by 7% between 2005-07 and 2013-15, though it remains above the OECD average (Figure 1.13). Under the 2009-15 RBMP, nitrogen emission reduction was 27% lower than initially planned (EC, 2016[93]) and nitrogen discharges into coastal waters were reduced by only 10%. The situation has not improved significantly under the 2015-21 RBMP. In 2017, only 1.7% of coastal waters, 20% of lakes and 30% of rivers had achieved good ecological status (Figure 1.17). The proposed Marine Strategy II, to be adopted by 2021, focuses on eutrophication risk management in coastal waters (MEF, 2018[94]). Less than half the country's groundwater bodies have good chemical status (Figure 1.17). Denmark's performance is below the EU average, but better than that of other intensively farmed countries in northern Europe, such as the Netherlands, Belgium and Germany (EEA, 2018[95]).

Figure 1.16. The status of water bodies has improved but remains an issue



Note: Quality of water bodies according to the standards of the EU Water Framework Directive. Change of methodologies in 2017.
Source: EEA (2018), *State of Water Assessment and EU Water Policy Context;* MF (2018), *Fremdriftsrapport på handlingsplanen for implementeringen af verdensmålene* [Progress Report on the Action Plan for Implementing SDGs].

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Denmark expects to achieve the WFD objectives for 50 of its 119 coastal water areas by 2021. To this end, EUR 830 million, more than half the 2015-21 RBMP budget, is devoted to wetland creation, afforestation, set-aside of agricultural land, catch crops and ecological focus areas (where agricultural production is prohibited). A further third of the budget goes to wastewater treatment and the remaining 13% is related to lake and river restoration. The third RBMP (2021-27) raises ambitions. In particular, Denmark will have to reduce nitrogen discharges into coastal waters to 44 700 tonnes per year by 2027, compared to around 60 000 tonnes per year in 2013-15.

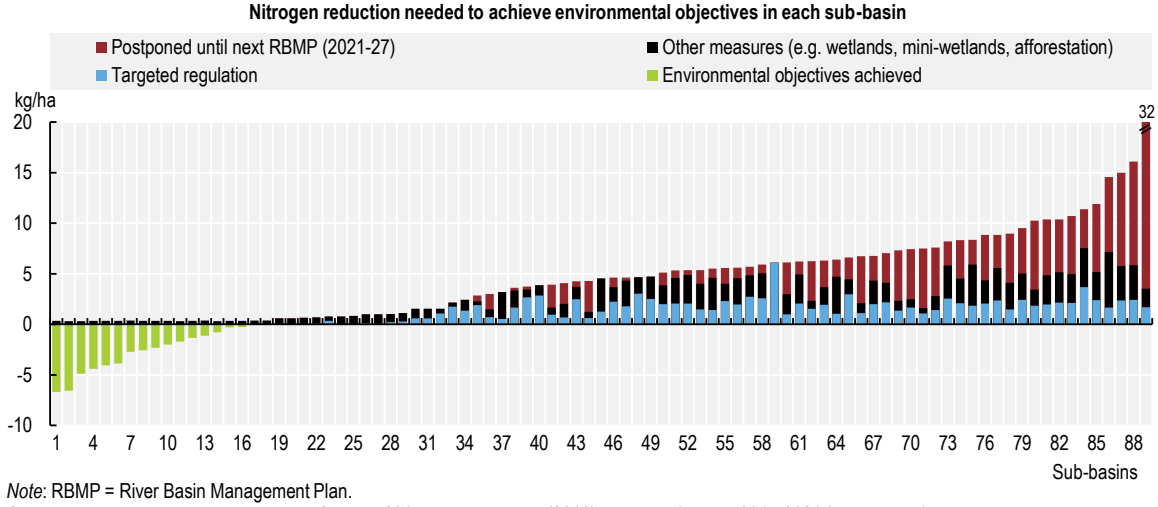
The presence of pesticides and their metabolites in groundwater remains a concern. In 2015-17, prohibited (legacy) pesticides were detected in groundwater intended for human consumption at levels exceeding the limit value for drinking water of 0.1 µg/l in 7.2% of

the 1 086 intakes surveyed. Authorised pesticides and their metabolites were detected at levels exceeding the limit of 0.1 µg/l in 1.6% of these intakes (GEUS, 2019[96])(Chapter 5). In 2019, municipalities were invited to review the effectiveness of protection zones around drinking water wells and to enforce the ban on the use of pesticides in these areas through voluntary approaches. If voluntary approaches prove ineffective by 2022, the government reserves the right to impose pesticide-free agriculture in the protection zones (MEF, 2019[97]). Some water companies have taken the lead in deciding to pay farmers not to use pesticides in these areas.

Main policies and measures

The 2015 Food and Agriculture Package introduced a policy change known as "targeted regulation". Until 2017, Denmark applied the same rules to all farmers by implementing the Nitrates Action Programme throughout the country. This regulatory base has been supplemented by a targeted catch crops programme since 2017 and targeted regulation since 2019. The package now provides for targeted regulation of agricultural practices, based on the risk of pollution of coastal waters. This is a step in the right direction as it improves cost-effectiveness by focusing efforts on vulnerable coastal areas in accordance with WFD provisions, although Denmark still takes a full-country approach with regard to the Nitrates Directive. Targeted regulation aims to focus nitrogen reduction efforts on watersheds threatened by nitrogen pollution (Figure 1.17), leaving farmers in other watersheds more flexibility in managing the use of their nutrients than was the case with non-targeted regulation (MEF, 2015[98]).

Figure 1.17. Efforts needed to reduce nitrogen emissions vary



Note: RBMP = River Basin Management Plan.
Source: Danish Environmental Economic Council, 2017. Based on MEF (2016), *Vandområdeplan 2015-2021 for Vandområdedistrikt Jylland og Fyn.*

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Recommendations on climate, air, biodiversity and water

Mitigating climate change

- Make every effort to achieve the goal of further reducing GHG emissions by 2030, including identifying misalignment of sectoral policies with climate policy, mobilising private finance and seeking synergies with other environmental policies (on air, water, waste, biodiversity).
- Develop a vision for a carbon-neutral Denmark by 2050, considering the development and export promotion of technological solutions (for energy efficiency, renewables, and CCS) and cost-effectiveness (including using international carbon markets to offset emissions).

Improving air quality

- Redouble efforts to reduce ammonia emissions so as to achieve the 2030 target set by the NEC Directive; in particular, seek synergies with nitrate policies, taking into account the nitrogen cycle; ensure policy coherence between ammonia emission management and expansion of biogas as a renewable energy resource.
- Continue efforts to address urban $PM_{2.5}$ pollution, including reducing particle emissions from residential wood burning.
- Strengthen international co-operation to support Denmark's efforts to control transboundary air pollution from international ship traffic.

Addressing biodiversity

- Update the 2014 Biodiversity Strategy in light of initiatives put in place since its launch (e.g. Nature Package, National Forest Programme, RDP, Green Map), and ensure their coherence; pending development of the Green Map by 2050, set intermediate targets for protected areas and connectivity, taking into account progress on the CBD Biodiversity Strategic Plan 2021-30.
- Provide sufficient public financial support to achieve the goal for "biodiversity forests" on both state-owned and private land; evaluate their impact, as well as that of the policy of increasing forest cover, on carbon sequestration.
- Establish a natural area connectivity strategy targeting threatened species, in close partnership with civil society and municipalities.

Improving water quality

- Continue to improve the cost-effectiveness of measures to reduce nitrate pollution of coastal waters; in particular, continue to implement the targeted regulation, focusing on watersheds at risk; estimate the effects of this targeted regulation on N_2O emissions with a view to seeking synergies.
- Improve the effectiveness of voluntary approaches to farmers in preventing pesticide use around drinking water abstraction wells; in particular, incorporate the suggestion that additional instruments will have to be applied if the objective of pesticide-free areas is not achieved.

Notes

[1] The Faroe Islands and Greenland are part of the Kingdom of Denmark. For the purposes of this review, data and figures refer only to continental Denmark unless otherwise stated.

[2] Annual fluctuations in TPES are largely linked to variations in coal supply for power generation. Denmark is part of the Nordic electricity market and variations in hydropower availability in Norway and Sweden have traditionally been balanced by coal-fired plants in Denmark (IEA, 2017[1]).

[3] The Kyoto Protocol established a cap-and-trade system, imposing national caps on the GHG emissions of developed countries that ratified the protocol. Each participating country is assigned an emission target and a corresponding number of allowances called Assigned Amount Units, which are tradable emission permits (Carbon Market Watch, 2012[102]).

[4] The MARPOL Convention introduced the emission control areas to reduce emissions of SO_X and NO_X in designated sea areas.

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Chapter 2. Environmental governance and management

Denmark has a well-functioning environmental governance and management system characterised by high levels of co-operation and consensus. However, there is scope to use existing strengths, such as expertise in socio-economic assessments and a comprehensive risk-based inspection system, to further strengthen policy making and gain a better understanding of non-compliance with environmental rules. This chapter provides an overview of developments in environmental governance and management in Denmark. It describes the institutional and legal framework, use of policy evaluation tools and mechanisms for compliance assurance. Finally, it examines efforts to promote environmental democracy through public participation, environmental information and access to justice.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

2.1. Introduction

Denmark has a well-functioning environmental governance and management system. It benefits from high levels of co-operation and consensus. Particular strengths include an informal system of cross-party political agreements, strong participation of civil society in policy making and high-quality independent advisory bodies. Inter-ministerial co-ordination on environment-related policies at the central level is well established. The country also has a comprehensive risk-based inspection system covering not only large installations, but also small and medium-sized enterprises.

Since a 2007 reform, Denmark's 98 municipalities have been responsible for most aspects of environmental management. To manage the transition, the country implemented a recommendation in the previous OECD Environmental Performance Review (2007) by setting up task forces to help municipalities carry out their new tasks. It also integrated monitoring of national environmental action plans in the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environment (NOVANA), in line with another recommendation. Finally, it used cost-benefit and cost-effectiveness analysis widely, e.g. based on updated guidelines on socio-economic assessment from 2017.

However, Denmark has not yet made it mandatory to apply the guidelines on socio-economic assessment when making government decisions touching on the environment or in regulatory impact assessment. While its risk-based inspection system is effective, the country does not yet make full use of inspection data to understand non-compliance among companies. Finally, there is a continued need for capacity building as well as guidance on implementation and the use of enforcement measures to help municipalities manage environmental challenges.

This chapter provides an overview of environmental governance and management in Denmark. It describes the institutional and legal framework, use of policy evaluation tools and mechanisms for compliance assurance. Finally, it examines efforts to promote environmental democracy through public participation, environmental information and access to justice.

2.2. Institutional framework

Denmark has a decentralised environmental governance system in which jurisdiction on the environment is shared among the national, local and, to a lesser extent, regional levels. The national level sets the legal framework and provides guidance on implementation. It also develops national plans, programmes and strategies. Local authorities are responsible for municipal and local planning; implementation of policies, plans and programmes; and issuance of most environmental permits and related inspection.

2.2.1. National institutions

The review period saw a number of changes in the distribution of environmental responsibilities at the national level. In 2007, a Ministry of Climate and Energy was established. Previously, climate change had been part of the Ministry of Environment. The rationale for a separate climate ministry was mainly the need to prepare for the 15th Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, held in Copenhagen in December 2009. The merging of the climate and energy portfolios facilitated reform of energy policy to support climate objectives, as evidenced by the ambitious Energy Agreements of 2012 and 2018. In 2015, economic regulation of

waste and water utilities was added to the portfolio, creating the Ministry of Climate, Energy and Utilities (MCEU).

In 2015, the Ministry of Environment and Ministry of Food and Agriculture were merged into the Ministry of Environment and Food (MEF), similar to the UK Department for Environment, Food and Rural Affairs. The rationale was to help balance the sometimes competing interests of the environment and agricultural policy. At the same time, the Ministry of Industry, Business and Financial Affairs (MIBFA) took on responsibility for the Danish Planning Act and national guidelines for spatial planning.

MEF and MCEU share jurisdiction on the waste and water sectors. MEF is responsible for environmental standards related to these sectors, while MCEU oversees their economic regulation, including the setting of rules on charges for the use of water services and waste collection services. The division of responsibilities took effect in 2015 to unite all utility sectors in one ministry and thereby facilitate a focus on improving their efficiency across the economy. In addition, a utility regulator under MCEU was established in July 2018. It oversees the electricity, natural gas and district heating sectors with a view to ensuring efficiency, the lowest possible prices for consumers, stable and secure energy supply, cost-effective technological development and green transition. The Utilities Secretariat in the Competition and Consumer Authority under MIBFA sets price caps and efficiency gain requirements for the water and wastewater sectors.

The Ministry of Transport, Building and Housing is responsible for policies in its portfolio areas. The Ministry of Taxation is responsible for legislation related to taxation and for collecting taxes, while the Ministry of Finance builds Denmark's public sector budget through the yearly Finance Act. It also provides cross-government policy co-ordination, e.g. as the secretariat of the government Economic Committee and as chair of ad hoc inter-ministerial policy committees.

Denmark stands out for its strong performance on inter-ministerial co-ordination. The government Finance Committee must approve all policies with major implications for public finances or the economy, including much environmental policy. The finance minister heads the committee, which is convened weekly. A Co-ordination Committee, headed by the prime minister, discusses environmental initiatives that are considered high priority, have significant foreign policy implications or affect Greenland and the Faroe Islands. It also meets weekly. In both committees, ministers with responsibilities in the environmental domain are invited to join the deliberations when files touch upon their responsibilities. Environmental impact assessments are included in the files when relevant, and revised if committee decisions differ from those proposed in the files so that the government is aware of the impact of its decisions on the environment. However, there is no requirement to follow specific guidelines on conducting environmental assessments.

In 2015, the government set up an EU Implementation Committee. It discusses business-related EU legislation. The aim is to ensure that implementation of EU rules does not put more burdens on Danish companies than EU law requires unless important considerations such as consumer protection justify it. An EU Implementation Council, consisting of experts and representatives from business, labour unions and consumer protection groups, advises the committee.

The Danish Environmental Protection Agency (EPA) is a technical agency in charge of environmental policy implementation, monitoring, permitting and inspections. It includes the Chemical Inspectorate and decentralised units in Slagelse and Aarhus inspecting the most complex and potentially most environmentally harmful companies. The Danish

Nature Agency manages MEF's approximately 200 000 ha of forests and natural areas. Within the agency, the Danish Coastal Authority is responsible for the protection of 7 300 km of coastline. The Danish Maritime Authority supervises and inspects ships sailing under the Danish flag and provides port state control over health, safety and environmental protection.

2.2.2. Subnational institutions

The Constitution guarantees municipalities the right to decide their own affairs under state supervision. The notion of municipal autonomy has continued to shape the role of municipalities. For example, more than 75% of municipal revenue comes from local taxation. While the national level provides a budgetary transfer in the form of a block grant, municipalities decide how it is spent. Equalisation between richer and poorer municipalities partly offsets differences in income levels, contributing to capacity in less affluent municipalities. Municipal budgets are determined in yearly agreements between the government and Local Government Denmark, which represents municipalities. If the government imposes new responsibilities on municipalities, it must compensate them for the cost through a transfer called a DUT payment. Public-private partnerships are not widely used by municipalities, e.g. in providing water and sanitation services.

In 2007, Denmark introduced a reform of its local administrative structure. The number of municipalities was reduced from 271 to 98, and 14 counties were replaced by 5 regions. In the process, most county environmental responsibilities were transferred to either the enlarged municipalities or the national level. Regions inherited limited environmental responsibilities, such as handling raw material extraction and contaminated soils (Box 2.1). In March 2019, the government decided that these responsibilities would be transferred to the national level.

Box 2.1. The 2007 municipal reform and the environment

In 2007, Denmark introduced a wide-ranging reform of the structure of its local authorities. The aim was to form larger, highly competent and financially sustainable municipalities of at least 30 000 inhabitants. The number of municipalities was reduced from 271 to 98, and 14 counties were replaced by 5 regions. The municipal reform saw a transfer of most county environmental responsibilities to the municipal or national level.

New municipal responsibilities after 2007

- Most public administration functions under Danish environmental legislation and citizen-related duties
- Preparation of action plans under the Environmental Objectives Act (protected areas), wastewater management plans, water supply plans and municipal waste management plans
- Maintenance of watercourses to allow free passage of water
- Municipal and local spatial planning

New responsibilities at national level after 2007

- Duties related to Denmark's international obligations, duties of major national

interest or technically complicated tasks

- Preparation of nature plans and River Basin Management Plans (RBMPs)
- Monitoring related to nature and the environment
- National guidelines for spatial planning and planning for the capital region
- Certain administrative functions, e.g. permits and inspections of the largest and potentially most environmentally harmful businesses and facilities, and protection of the coastline

Responsibilities for the new regions after 2007

- Regional development plans
- Mapping, planning and permitting for raw material extraction
- Management of contaminated soil
- Certain duties under the Environmental Objectives Act

Source: (MEAI, 2015[1]).

The 2007 Environmental Performance Review of Denmark recommended setting up capacity-building mechanisms to help municipalities carry out new environmental management tasks. The national level has done this by establishing task forces that provide free assistance to municipalities in environmental planning. They have covered areas such as installation of wind turbines and biogas plants, municipal climate adaptation plans, groundwater protection and permitting of livestock farms. The EPA also issues guidance to municipalities on how to implement environmental legislation. Further such guidance could be strengthened by learning from international best practice, e.g. Switzerland's enforcement aids to cantons.

In March 2013, an evaluation concluded that the municipal reform had succeeded in creating a framework for a more robust public sector. It found that technical expertise and financial sustainability had generally been improved and that political decision making in municipalities had become more strategic. At the same time, the evaluation pointed out that the potential benefits in efficiency gains and quality had not yet been fully reaped (MEAI, 2013[2]).

Concerning the environment, the evaluation recommended more inter-municipal co-operation on nature and water management. It also noted that the reform had divided responsibility for permitting and inspecting the most environmentally complex companies (those covered by the EU Integrated Pollution Prevention and Control [IPPC] Directive) between the municipalities and EPA. However, maintaining the expertise to handle the companies at municipal level was challenging, since half the municipalities had fewer than four such companies in their jurisdiction. Therefore, the evaluation recommended that the government should consider transferring permitting of all companies under the directive, excluding livestock farms, to the national level. Alternatively, as landfills accounted for a substantial share of the companies, it recommended uniting landfill permitting (a municipal responsibility) and inspection (an EPA task) at either the national or municipal level, to avoid inconsistency. Similarly, the evaluation recommended unifying planning and permitting of raw material extraction at either the regional or municipal level.

In June 2013, all parties in the Danish Parliament reached a political agreement on adjustments to the structural reform. These included decisions to transfer landfill permitting from the municipal to the national level and permitting of raw material extraction from the municipal to the regional level, the aim being to improve technical capacity and efficiency. However, they decided not to transfer to the national level permitting and inspection of all non-livestock companies covered by the Industrial Emissions Directive, which had since replaced the IPCC directive. Municipalities continue to be responsible for some types of these companies, e.g. in the area of waste management, under Statutory Order No 1517 of 07/12/2016 on environmental permits.

To address the recommendation on more inter-municipal co-operation in water and nature management, a joint working group between the national level and Local Government Denmark was formed to support municipalities in this area. The introduction of river basin management has since improved cross-municipal co-operation on water management. In addition, a major initiative on wetlands launched by MEF in 2010 led to grouping of municipalities at the catchment level to ensure cohesion in decision making. Denmark should expand the use of task forces to build municipal capacity in environmental management areas where it faces challenges, such as waste prevention (Chapter 4).

2.3. Legal framework

Denmark is a parliamentary democracy characterised by proportional representation, minority governments and a high level of cross-party co-operation. To enhance political stability and policy continuity, governments often seek to form political agreements with parties outside government on key policies (Box 2.2).

Box 2.2. Cross-party political agreements

Since the early 20th century, political parties in the Danish Parliament have used written political agreements as a legally non-binding tool outside the normal legislative process. Parties that enter into a political agreement commit themselves to support the legislation necessary to implement it. This is a way for minority governments to be sure that a parliamentary majority supports its legislative proposals before it presents them to Parliament. More importantly, parties use political agreements to "bind" each other to decisions that may prove unpopular (e.g. structural reform) or for which long-term continuity is key (e.g. incentives for companies to invest in renewables).

Governments often publish plans, strategies or proposals as a starting point for negotiations on political agreements. For example, the government's energy proposal of April 2018, "Energy for a Green Denmark", was followed by negotiations leading in June 2018 to a political agreement by all parties in Parliament. Political agreements in the environmental area also cover areas including the Danish climate law, spatial planning, nature policy, circular economy, regulation of the waste management sector, chemical management, pesticide management, targeted nitrogen regulation, and phosphorous regulation of livestock farms.

Source: (Christiansen, 2008[3]).

Denmark led the 2012 OECD Environmental Policy Stringency Index, which measured the policy-induced cost of pollution by firms across a range of sectors and policy instruments

(OECD, 2016[4]). Perceived policy stringency has been shown to be a key factor in bringing about improved environmental performance in companies (OECD, 2007[5]).

The Environmental Protection Act, last amended in 2017, is the central piece of legislation on prevention and management of pollution in Denmark. It sets general quality requirements for air, water, waste, soil (above and below ground) and noise. The act sets out fundamental environmental protection objectives and the means by which they are to be met. It is a framework act, supplemented by guidelines and statutory orders issued by MEF.

The Environmental Objectives Act, last amended in 2016, governs protected areas, including the management of Natura 2000 areas. Under the act, the environment minister designates internationally protected areas and prepares a plan for each Natura 2000 area. Municipalities are charged with preparing action plans for each area to implement the national plans locally.

The Soil Contamination Act, last amended in 2016, charges the regions with mapping and managing contaminated soil. It partly transposes the EU directives on environmental liability and industrial emissions. The Environmental Damage Act, last amended in 2017, is the main legislation transposing the Environmental Liability Directive. It applies the polluter-pays principle by establishing that the responsible party must bear the costs associated with preventing or remedying ecological damage.

Denmark has a good record on the speed and quality of transposition of EU environmental legislation. There have been few complaints and infringement cases (Table 2.1). Denmark is also highly active at the EU level on many environmental files. One example is the updating of EU legislation on the registration, evaluation, authorisation and restriction of chemicals (REACH), which entered into force in 2007 (Chapter 5).

Table 2.1. Infringements of EU legislation

Directive	Concern	Decision type	Decision data
Environmental Liability Directive 2004/35/CE	Transposition in Danish legislation	Formal notice	2016
Ambient Air Quality Directive 2008/50/EC	Breach of compliance with NO_2 limit values	Formal notice	2016

Source: European Commission (infringement decisions against Denmark as of December 2018).

The review period has seen important changes to Danish environmental legislation. The 2014 Climate Act, for example, established an independent Climate Council to advise the government on matters such as how to achieve climate targets cost-effectively. The government must respond to the council's recommendations in a yearly climate report to Parliament. The law requires the government to set national greenhouse gas (GHG) reduction targets at least every five years with a ten-year time frame.

In 2013, Parliament adopted a revised Water Planning Act, transposing the EU Water Framework Directive (WFD) and establishing the legal framework for river basin management. It provides for active involvement of civil society in the drafting of RBMPs through municipally managed water councils comprising representatives from environment and agriculture groups. To facilitate their work, the government informs them of the cost-effectiveness of measures that could be implemented in the watershed.

In 2015, Parliament adopted the Food and Agriculture Package. Consequently, changes have been made to the Fertiliser Act and Animal Husbandry Act to boost food production

while respecting environmental legislation by applying a more targeted approach to nutrient pollution mitigation efforts.

2.3.1. Direct environmental regulation

Over the years, Denmark has made extensive use of pricing instruments, such as taxes and charges, and financial support instruments to manage environmental issues (Chapter 3). Nevertheless, direct environmental regulation is still the main approach used for environmental policy instruments.

While the ultimate goal of such regulation is to improve environmental quality (e.g. urban air quality), it may not be practical to ascribe such a result to a single policy intervention. In such cases, direct regulation can be defined in terms of outcome (e.g. vehicle emission standards) or design (e.g. use of a particular technology, such as particle filters). Its effectiveness can thus be measured in terms of result, outcome or design.

Introducing flexibility in direct environmental regulation can help reduce compliance costs, particularly regarding how to reduce emissions, for example when a design-based standard requiring the use of a specific abatement technology is replaced by an outcome-based standard that sets pollutant emission limits (OECD, 2018[6]). This allows companies to abate or reduce emissions at the source and by whatever means is convenient; they can select a process in their plant for abatement and also compensate emissions with reductions at other sources.

Denmark increasingly favours outcome-based over design-based direct regulation to give producers more flexibility on how to comply. Regulation of excess nutrients from farms is a good example. In 2015, Denmark decided to replace a requirement to establish buffer zones without fertilisers, crops or pesticides along certain streams and lakes with a more targeted regulation giving farmers flexibility on the choice of abatement measures (Box 2.3). Similarly, environmental permits for livestock farms require the use of best available techniques, expressed as an outcome level of emissions from farms to the environment. Farmers are free to choose among available techniques or technologies.

Box 2.3. Targeting nitrogen regulation improves cost-effectiveness

Excess nitrogen from agriculture is a main source of pressure on water quality in Denmark's coastal waters and fjords. Uniform regulation, such as farm-level nitrogen quotas, has helped reduce the excess. However, since water pollution risk varies widely across the country, this has been suboptimal from both an environmental and a cost-effectiveness perspective. To improve water quality in a more targeted (i.e. risk-based) way, Denmark is implementing a new policy. For each of its 90 river sub-basins, it has estimated how much excess agricultural nitrogen must decrease for coastal waters to attain good status under the WFD. In parallel, it has estimated the amount of nitrogen retained in soil on the way from farms to coastal waters, based on 3 000 units.

By combining the required reduction in each sub-basin with retention rates in soil, Denmark determines the effort that must be made in each of the 3 000 units. Efforts to reduce excess agricultural nitrogen are thus differentiated according to the risk of water pollution (the extent to which each coastal water needs protection) and cost-effectiveness (where abatement measures are most effective). Public financial support is available on request. It is combined with an uncompensated direct regulation backstop mechanism if

voluntary participation is insufficient to achieve the required reduction. To ensure cost-effectiveness at farm level, farmers can freely choose among abatement measures whose effect has been documented by Danish universities.

An international expert panel found that Denmark had achieved the highest possible standard of WFD implementation with respect to methodology and determination of required actions (MEF, 2017[7]).

2.3.2. Land-use planning

The Spatial Planning Act, last amended in 2018, provides a national framework for spatial planning that seeks to balance the need for environmental protection with economic development and growth. Municipalities are responsible for translating national guidelines into concrete spatial planning (Figure 2.1). To this end, they issue municipal plans every four years with a 12-year time frame. Local plans are the most detailed level of spatial planning. They establish rules on how land can be used and developed (OECD, 2017[8]). MIBFA can reject municipal plans that do not adequately take national guidelines into account. Municipal plans must address climate adaptation needs and reflect the Green Map of Denmark (Box 2.4). A 2017 reform of the act gave municipalities more flexibility to promote growth and development with continued respect for nature and environment. One example is more flexible building opportunities in rural and coastal areas.

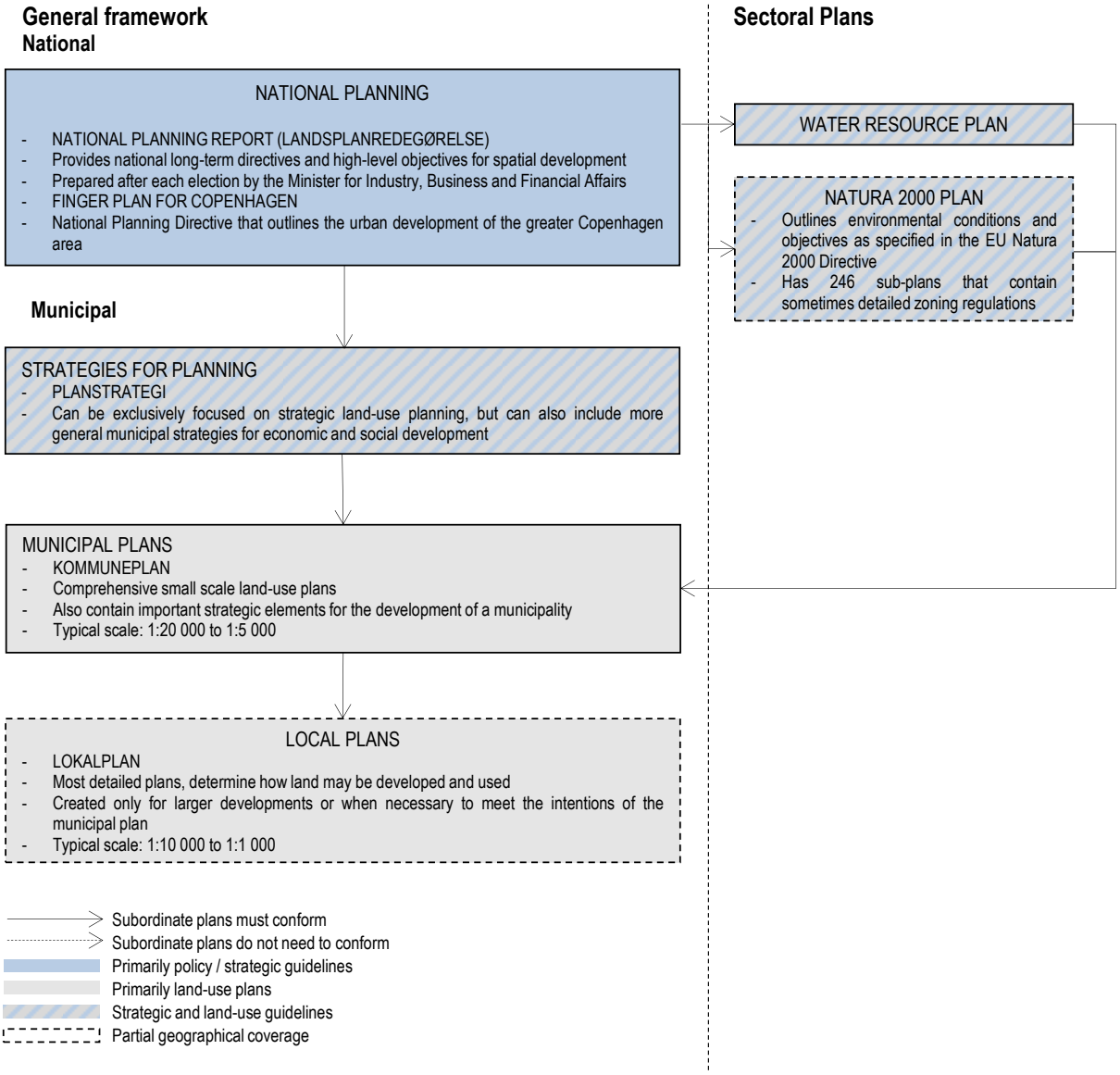
Box 2.4. Green Map of Denmark

Amendments to the Spatial Planning Act in 2015 and 2017 introduced requirements for municipalities to plan and designate existing and potential natural areas and wildlife corridors, including existing Natura 2000 sites, on the Green Map of Denmark. The aim of the map is to improve biodiversity by reinforcing efforts to establish larger and more interconnected natural areas and ensure coherence between designations in neighbouring municipalities. The map shows not only existing nature but also where there is a potential to create larger natural areas, such as forests and heaths. The map is continuously developed and expanded as municipalities review their municipal plans every four years.

The Nature Map, a planning tool developed by the EPA and MEF, is available to municipalities to support their work on designating nature areas for the Green Map. It includes an overview of where endangered species are found and where efforts can be targeted, and provides information on important high nature value habitats and potential forest habitats.

Source: (MEF, 2014[9]).

Figure 2.1. Land-use planning framework



Source: Adapted from (OECD, 2017[8]).

Farmland takes up more than 60% of the country's surface area. Farming puts pressure on the environment, especially on peatland (drained peatland is a net source of GHGs) or close to sensitive natural areas and water bodies. Since 1990, land consolidation and land banking have proved essential to improve both agricultural productivity (through structural adjustment) and nature conservation (by offsetting nature conservation land with agricultural land) (Hartvigsen, 2014[10]). However, public funding for land redistribution has been significantly reduced since the discontinuation of the structural adjustment policy in 2006. In 2018, a Multifunctional Land Redistribution Fund (MLRF) was established with a budget of EUR 33 million. In February 2019, Denmark's two main environmental and agricultural interest groups jointly recommended raising it by at least EUR 130 million (Danish Society for Nature Conservation and Danish Agriculture & Food Council, 2019[11]). The aim is to be able to seize opportunities to buy land where farming has a

significant environmental impact, such as peatland and soil close to ammonia-sensitive nature areas or drinking water boreholes, and resell it for conversion to natural areas or grassland as well as to support rural development and access to landscapes and nature.

Conversion of peatland could reduce agricultural GHG emissions by some 15% through carbon sequestration (Dubgaard and Ståhl, 2018[12]). However, EU policies limit the potential. Farmers lose income support under the Common Agricultural Policy when agricultural peatland is converted to nature areas. In addition, the EU 2030 climate and energy framework caps how much member states can use carbon sequestration to meet reduction targets for sectors not included in the EU Emissions Trading System. Scaling up conversion of peatland would support Denmark's ambition to become carbon neutral by 2050. It would also deliver co-benefits for biodiversity, water and air quality, and climate adaptation. However, the merit of scaling up public funding of the MLRF with respect to expected environmental policy benefits requires cost-effectiveness analysis.

In addition to budgetary resources, private funds could be mobilised to finance the MLRF. Denmark has shown leadership in this area through the Climate Investment Fund. Recent OECD work illustrates the range of interventions public actors can use to attract institutional investment in low-carbon infrastructure, which could include the land purchase envisaged by the MLRF (Röttgers, Tandon and Kaminker, 2018[13]).

2.4. Policy evaluation framework

The EU Strategic Environmental Assessment (SEA) Directive was transposed into Danish law in 2004. The resulting Environmental Assessment Act, last amended in 2016, requires ministries to conduct SEAs of plans and programmes that may significantly affect the environment. Examples of SEAs conducted in the review period include a SEA of changes to the regulation of fertiliser use by farmers in the Food and Agriculture Package and a SEA of the choice of location of marine wind turbines following the 2012 Energy Agreement. The system of political agreements means a SEA is sometimes performed after a political decision is made, in which case implementation can be conditional on the SEA showing compatibility with legal constraints, e.g. EU environmental law.

Important government plans and programmes typically rely on extensive prior assessment of the costs and benefits of targets or the cost-effectiveness of measures. Since many environmental targets in Denmark are set at EU level rather than nationally, cost-effectiveness assessments are more widely used than cost-benefit analysis. Nevertheless, MEF and other ministries have increased their efforts on cost-benefit analysis. In 2017, the Ministry of Finance published a revised set of guidelines on socio-economic assessment of the costs and benefits of major initiatives (MF, 2017[14]). The value of statistical life was increased from DKK 18 million (EUR 2.4 million) to DKK 31 million (EUR 4.2 million), making the benefits of air pollution measures, for instance, more likely to outweigh the costs. A recent example of a cost-benefit analysis is the government proposal to tighten restrictions on vehicles in green zones in the largest cities, which was included in the 2018 Climate and Air Pollution Proposal and approved later that year.

In 2014, MEF tasked academics with preparing an *ex ante* cost-effectiveness analysis of possible measures in RBMPs for 2015-21 (DCA, 2014[15]). An inter-ministerial working group produced a similar analysis of possible GHG mitigation measures in 2013 (MEUC, 2013[16]), and potential GHG mitigation measures in the agricultural sector underwent analysis in 2018. Cost-effectiveness analysis was also performed in preparation of the 2013

national waste plan and in 2013 and 2014 on implementation of the EU National Emission Ceilings Directive.

In addition to effects within its borders, when conducting cost-benefit analysis of environmental policies Denmark should consider separately quantifying effects elsewhere, e.g. health benefits in neighbouring countries resulting from Danish air pollution measures. Quantifying effects in and outside Denmark separately would give politicians the information needed to evaluate policy options on a national or international basis, as they choose (OECD, 2018[17]). More generally, making use of the guidelines on socio-economic assessment mandatory for government decisions with a significant environmental impact could further strengthen policy making. However, the consequences for government decision-making processes should be assessed before such a change is implemented.

Primary legislation (laws) must contain a regulatory impact assessment (RIA) covering the environment. The RIA must also assess economic and administrative burdens for companies and public authorities, and administrative burdens for citizens (PMO, 1998[18]). RIAs included in draft primary laws are released for consultation by the public before the bills are debated in Parliament, in line with OECD best practice (OECD, 2017[19]). However, Danish RIAs usually do not include comparison with alternative policy options, unlike European Commission RIAs, for example. They are typically less comprehensive than a full cost-benefit or cost-effectiveness analysis. Hence they could also benefit from mandatory use of the guidelines on socio-economic assessment. Finally, Denmark has one of the OECD's largest gaps between the levels of impact assessment of primary legislation and of subordinate regulations (statutory orders). This may be because many statutory orders in Denmark are merely decrees of application of the primary law. In such cases, it may not be relevant to conduct an additional RIA (OECD, 2018[20]).

Denmark conducts *ex post* evaluation of important policies, plans, programmes and political agreements. For example, an evaluation of the pesticide tax and reduction target was made public in 2018 (EPA, 2018[21]). Energy taxes and support under the 2012 Energy Agreement were also subject to extensive *ex post* evaluation. The findings fed into preparation of the 2018 Energy Agreement and led, for example, to a commitment to lower the electricity tax. The 2007 Environmental Performance Review recommended prioritising monitoring of national environmental action plans. This is now included in NOVANA.

An independent body, Rigsrevisionen, audits public spending on behalf of the Danish Parliament. It audits government accounts and financial statements of publicly funded enterprises, and verifies the legality and efficient use of public funds. It also conducts in-depth studies of specific policy areas. Parliament may request a statement by the responsible minister on specific reports. The statement is then evaluated by Rigsrevisionen, which sends the evaluation to Parliament for review, thus ensuring follow-up and political accountability.

Following a 2014 Rigsrevisionen report, Parliament's Public Accounts Committee criticised the former Ministry of Environment for its management of the first RBMPs (2009-15). These were subject to delays and dissatisfaction concerning stakeholder involvement. Scrutinising the management of the second RBMPs (2015-21), Rigsrevisionen found that the ministry had followed its recommendations and proposed closing the case (Rigsrevisionen, 2018[22]).

Independent advisory bodies such as the Environmental Economic Council and the Climate Council are also mandated to evaluate public policies *ex post* and to make *ex ante*

recommendations with a strong focus on improving cost-effectiveness. The Environmental Economic Council was formed in 2007 to supplement the Economic Council. The two councils share the same four-person presidency of renowned economists, usually from the academic world. They prepare one report per year on policy issues at the interface of economics and the environment. The Environmental Economic Council, which consists of the presidency and a wide range of public sector and civil society representatives, meets to discuss and comment on the report.

The Climate Council established by the 2014 Climate Act is an expert group charged with evaluating compliance with climate targets, analysing pathways for Denmark to become a low emission country by 2050, issuing recommendations on climate policy and mitigation measures, and contributing to the public debate.

2.4.1. Environmental impact assessment and permitting

Under the Environmental Impact Assessment (EIA) Act, last amended in 2017, EIA must be carried out on building and construction projects before the contractor is granted permission to begin the project. EIA is integrated into the permitting process.

In 2015, the Environmental Protection Act and the Spatial Planning Act were amended to reduce processing times for environmental permits and ease the administrative burden for companies and authorities, while at the same time maintaining the stringency of environmental law. The amendments followed 2014 political agreements on a Growth Plan for Food and a Growth Package. The purpose of the latter was to reduce the time it takes the central government to process files for environmental approvals by 20% and municipal processing time by 33%. The government estimated that, from 2017, the time savings would represent an annual administrative gain of DKK 4.3 million (EUR 0.6 million) for industry and lead to an increase in turnover of DKK 61 million (EUR 8.2 million) per year due to enterprises starting new production more quickly.

The Order on Environmental Permitting, last amended in 2018, covers some 4 400 companies. They must apply for an environmental permit before starting production or significantly changing or expanding their activities. Livestock farms are covered by a separate Order on Livestock Environmental Permitting. It takes into account risks regarding excess nutrients to groundwater, lakes and coastal waters and the adverse impact of ammonia emissions on protected areas, among other matters.

2.5. Compliance assurance

2.5.1. Environmental inspections

Municipalities conduct most environmental inspections, using EPA guidelines. The EPA inspects the most complex companies with the most serious potential impact on the environment. These include energy plants, metal and mineral producers and processors, the chemical industry, shredder waste managers, landfills, hazardous waste managers, and incinerators (Statutory Order No. 1317 of 20/11/2018 on Environmental Permits). The EPA and municipalities jointly oversee imports of waste for treatment.

The approximately 700 municipal inspectors in Denmark's 98 municipalities conducted around 17 000 environmental inspections in 2017. Municipal inspectors are not accredited, but employed on the basis of their educational background and professional experience and trained through Local Government Denmark. MEF supports municipalities in their inspection and licensing tasks through its Project Digital Business, and organises briefings

on EU reference documents on best available techniques. Some 50 EPA employees are responsible for permitting and inspection of 300 industrial sites covered by the Industrial Emissions Directive and about 30 sites covered by the Seveso Directive. They conduct 250 to 300 inspections per year.

In 2010, MEF launched its second enterprise committee, whose work resulted in recommendations regarding simplification and updating of the corporate environmental regulatory system. The recommendations led to reorganisation of environmental inspections. Denmark now takes a risk-based approach to environmental inspection, in line with the Industrial Emissions Directive.

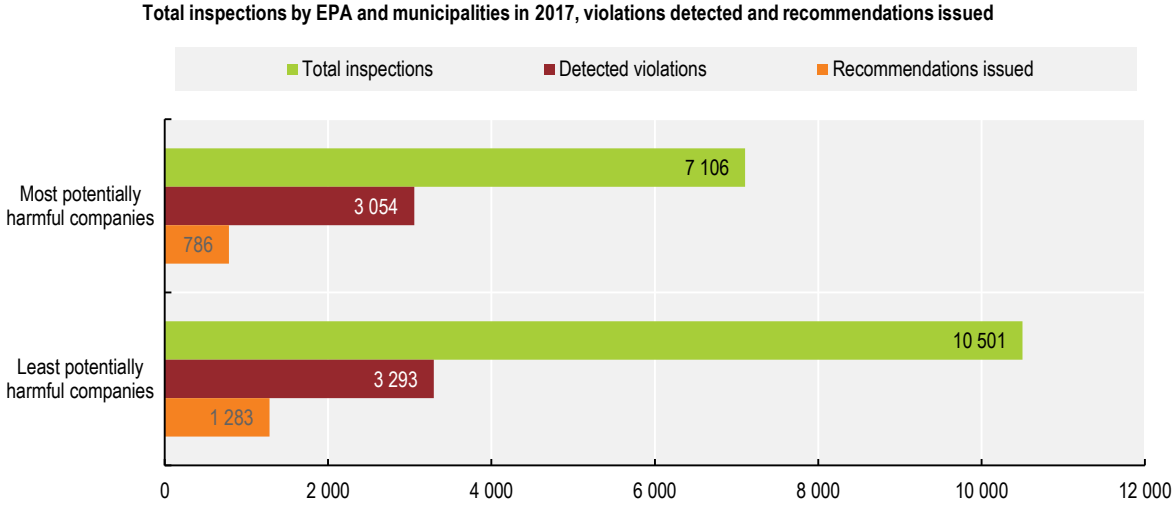
It assigns a risk score to companies based on five parameters with differing weights: use of environmental management systems (20%), previous rule compliance (30%), storage of chemicals or other hazardous substances (16.5%), emissions to air, soil or water (16.5%) and proximity to environmentally sensitive areas (17%). The potentially most environmentally harmful companies are inspected at least every three years, as the directive requires, while the least potentially harmful are inspected at least every six years. In both cases, the frequency of inspection is increased if the companies' risk score justifies it (Statutory Order No. 1476 of 12/12/2017 on Environmental Inspections). Applying a risk-based inspections system to even the least potentially harmful companies is good practice.

In 2018, an external evaluation concluded that the risk score was generally effective but that certain aspects could be improved. Among its recommendations were differentiating between minor and major violations of rules when assessing the rule compliance parameter (Ramboll, 2018[23]).

Until 2016, each municipality produced a yearly report on its environmental inspections, but these data were not systematically compiled at the national level. In 2016, Denmark introduced a central database collecting data from all inspections. This is a positive step, as it gives an overview of the total number of inspections and violations. In 2017, out of 7 106 inspections of the most potentially environmentally harmful companies, 3 054 violations were detected (Figure 2.2). Among 10 501 inspections of the least potentially harmful companies, 3 293 violations were detected. The share of companies violating environmental rules is not known, as several violations may be found in a single inspection.

The numbers suggest that the Danish inspection system is effective. The risk-based approach helps authorities identify companies likely to breach environmental rules. The results also show that the companies posing the biggest potential risk to the environment are subject to the most compliance promotion and enforcement measures. Denmark is starting to use the database more strategically to improve its inspections efforts. From 2020, it plans to target guidance to industries where inspection data point to a need for special efforts to bring down the number of violations. Making fuller use of the database should help Denmark gain a better understanding of non-compliance among companies and inform policy making.

Figure 2.2. The inspection system is effective in finding violations, but the share of companies violating environmental rules is unknown



Note: The Danish EPA has communicated that even minor infractions, such as failing to register a required environmental improvement even though it has in fact been implemented, is considered a violation under the current inspection system. The fact that a recommendation has been issued does not mean that the company has violated environmental rules. It is rather a preventive measure intended to avoid future violations and/or improve environmental management.
Source: Country submission.

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Denmark is introducing innovative techniques to support inspections. For example, in relation to sulphur pollution from ships leaving the Baltic Sea through Danish waters, it has started using sensors to single out ships for inspection (Box 2.5)

Box 2.5. Monitoring sulphur pollution from ships crossing Danish waters

To determine vessel compliance with international sulphur regulations, as outlined by the International Maritime Organization in MARPOL Convention Annex VI, Denmark runs controls on ships passing through its waters. The authorities monitor emissions from ship funnels using a sniffer installed on a helicopter or drone (a plane was formerly used), as well as one on the Great Belt Bridge. In 2017, between July and December alone, 404 ships were checked and a substantially elevated sulphur content was found in 22 of them (5.4%). This was the first time that micro-sensor technology, in the form of a mini sniffer system, was officially used.

If too much sulphur is detected, the Danish Maritime Authority is informed and the ship is further checked at a Danish port, as oil samples are required as proof. Since 2015, 21 companies have been reported to the authorities, and 7 have been fined thus far. For ships heading to non-Danish ports, the EPA notifies the relevant authorities that there may be grounds for monitoring. It shares monitoring information with other EU countries via the THETIS port state control database, allowing EU and national authorities to act on the information. To strengthen enforcement of the sulphur regulations, in October 2018 the Danish environment minister presented a legislative proposal to Parliament that would allow the EPA to publicly "name and shame" non-complying companies.

Aarhus University estimated that the stricter regulation more than halved the sulphur content of the air over Denmark. Two subsequent reports concluded that some 95% of ships now respect the sulphur limits. Given that all ships entering or leaving the Baltic Sea need to pass through Danish waters, this monitoring, if supported by action by other countries in the region (e.g. in response to Danish authorities' notifications), can be considered a best practice contributing to the improvement of air quality in the region.

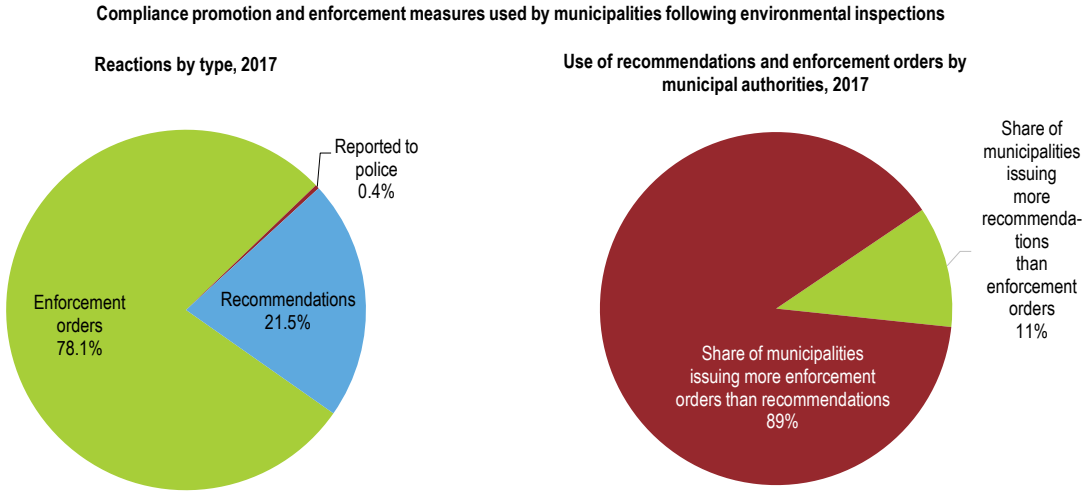
Source: (Explicit ApS, 2018[24]), (EPA, 2017[25]), (ITF, 2016[26]), (MEF, 2017[7]).

2.5.2. Enforcement and environmental liability

Danish authorities have three categories of compliance promotion and enforcement measures at their disposal: reporting companies to the police, issuing enforcement orders prescribing corrective actions and issuing non-binding recommendations. If authorities detect violations during an inspection, they must issue an enforcement order. In the most severe cases, they report companies to the police. However, this occurred in just 30 cases out of some 17 600 inspections in 2017. As a preventive measure, authorities may issue recommendations to help companies improve environmental management and avoid future violations. These can take the form of non-binding agreements on specific improvements.

Guidance documents on compliance promotion and enforcement measures have existed since 2005 (EPA, 2005[27]), but in practice, municipalities vary widely in their use of the measures. In 2017, recommendations made up 21.5% of reactions recorded following inspections of the potentially most environmentally harmful companies (Figure 2.3). However, 11% of municipalities opted for a more instructive (less punitive) approach by choosing to use recommendations more often than enforcement orders. Eight of these municipalities issued recommendations five times more often than enforcement orders.

Figure 2.3. Municipalities enforce environmental rules differently



Note: Data refer to inspections carried out by municipalities in the most potentially harmful companies.
Source: Country submission.

Different types of industries are not evenly distributed across the country. Since different industries give rise to different kinds of environmental issues, applying compliance promotion and enforcement measures to the exact same degree across municipalities should

not be an aim in itself. However, the same types of companies should experience uniform treatment irrespective of the municipality they are based in. To thus level the playing field for companies, national authorities should ensure that municipalities promote compliance with environmental rules and enforce them in a comparable manner, while respecting municipal autonomy and taking differences in the regional distribution of industries into account (Mazur, 2011[28]).

In 2017, MEF launched a new enforcement strategy for its agencies, including the EPA (MEF, 2017[29]). It includes scaling up guidance efforts and ensuring transparent and uniform treatment of companies. The results of this strategy should be used to provide municipalities with additional, evidence-based criteria for identifying appropriate compliance promotion and enforcement measures. In addition, the EPA could illustrate its guidance documents with examples from actual cases in municipalities.

Section 196 of the Danish Penal Code makes it a crime to pollute air, water, soil or the underground to such an extent that the pollution causes significant damage or immediate danger of damage to the environment. It is also a crime to store or remove waste or similar substances where it causes significant damage or immediate danger of damage to the environment. Violations of environmental law of a systematic or organised nature are also considered crimes.

The most severe penalty for an environmental crime given during the review period was in a case decided by the Danish High Court in 2017. Two men were sentenced, one to three years in prison and the other to three years and nine months, for crimes including disposal of waste in a forest in violation of paragraph 196 of the Criminal Code. However, criminal liability is reserved for the most serious breaches of environmental law. In less serious cases, Denmark applies the polluter-pays principle, requiring the polluter to bear the cost of remedying the environmental damage.

Denmark transposed the EU Environmental Liability Directive in 2008 and has published a comprehensive guidance document on its application. It has not yet experienced any cases of environmental damage to which the directive applied. In 2016, the European Commission launched an investigation into whether Danish legislation was compatible with the directive.

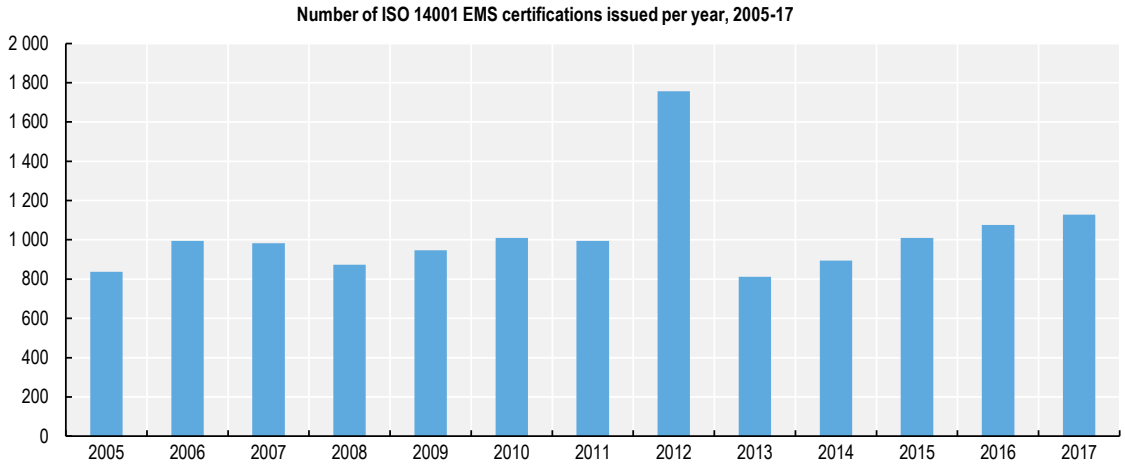
The context of violations of environmental rules differs between the most and least potentially harmful companies. Increasingly, the least potentially harmful companies are not required to have environmental permits but must comply with general rules. To promote their compliance, information measures in line with the inspection strategy might be useful.

The most potentially harmful companies must have environmental permits, which give detailed guidance on how each company is to comply with environmental legislation. Nevertheless, more violations are found among these companies than among those without permits. This suggests that lack of guidance is not the underlying issue. Making fuller use of the database on inspections would help shed light on reasons for non-compliance.

2.5.3. Promotion of compliance and green practices (certification)

The number of Danish companies adopting the ISO 14001 environmental management system was between 800 and 1 000 for most years in the review period (Figure 2.4). After a sharp peak in 2012, from 2013 to 2017 the yearly number increased gradually to reach its second highest level in 2017. An explanation for the fluctuation may be the impact of public support programmes that have promoted uptake of environmental management systems.

Figure 2.4. Enterprises adopting environmental management systems peaked in 2012



Source: ISO (2018), *ISO Survey 2017*.

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Denmark does not have an Environmental Code but is attempting to make compliance with environmental legislation easier. To this end, a simplification exercise is being undertaken to reduce the number of regulations related to the environment and food production. It is intended to be a technical legal reorganisation exercise that will not alter existing environmental protection. The aim is to improve legal certainty for citizens and companies by consolidating the relevant legislation and organising it more logically, which will also ease the administrative burden for public authorities.

As a first step, MEF reorganised and merged statutory orders and annulled orders that were no longer applicable. When that exercise was finished in 2016, the number of orders had been reduced by a third without changing the legal stringency of environmental protection. As a second step, a panel of legal experts in the environmental field, chaired by the ombudsman's office of the Danish Parliament, were tasked with proposing a new structure for laws covering the environment and food production. The panel published its recommendations in December 2017 under the title "The Law Compass". It recommended a simplified and modernised legal structure that would reduce the number of laws from 95 to 43 without changing the level of environmental protection (Law Compass Expert Panel, 2017[30]). Initial steps to follow up on these recommendations have been taken, such as repeal of obsolete rules on agriculture. Denmark should further pursue such efforts in order to promote compliance and enforcement.

2.5.4. Voluntary agreements

Governments sometimes use voluntary agreements with business as an alternative or supplement to other policy instruments (e.g. direct environmental regulation, taxes, tradable emission permits), as they are thought by some to be more flexible, efficient or consensus-based. However, if voluntary agreements are not backed by a credible threat of more restrictive action should targets not be met, they risk adding little value while incurring administrative costs for both authorities and companies (OECD, 2003[31]).

Denmark's use of agreements and formalised partnerships between the public and private sectors on the environment reflects a tradition of civil-society involvement in policy

making. Such arrangements also help create consensus and continuity on environmental policies, a preference reflected in the system of informal cross-party political agreements as well. When voluntary agreements include quantitative targets, they are backed by explicit threats of regulatory action (Table 2.2).

Table 2.2. Voluntary agreements with quantitative targets are backed by threats of regulation

Voluntary agreements between government and industry concluded between 2005 and 2018

Name of agreement	Years active	Sector	Quantitative target	Explicit threat
Partnership on precision spraying	2017-21	Agriculture and natural resources	No	No
Partnership on green shipping	2016-	Transport	No	No
Agreement on electrical and electronic waste	2014-16	Waste	No	Yes
Agreements regarding aquatic environment	2009-21	Water	Yes	Yes
Partnership on green public purchasing	2006-	Multiple	No	No
Agreements on Energy Savings Obligations	2006-20	Energy	Yes	Yes

Source: Country submission.

2.6. Promoting environmental democracy

2.6.1. Public participation

Denmark provides for excellent public participation in environmental matters, according to the European Commission (EC, 2017[32]). Across policy areas, the OECD regulatory policy and governance indicator shows Denmark to be slightly above the OECD average in terms of stakeholder engagement in development of legislation (OECD, 2017[19]). Stakeholder engagement is more comprehensive in primary legislation (laws) than in subordinate regulations (statutory orders). This follows the same pattern as EIA, possibly because some statutory orders are simply application decrees of primary laws.

The government aims to have four weeks of public consultation on both primary laws and statutory orders, although it is not a legal requirement. The aim is generally respected on primary laws and, when practical, on statutory orders.

2.6.2. Access to environmental information

The Environmental Information Act, last amended in 2017, constitutes Denmark's implementation of the EU Directive on Public Access to Environmental Information, which in turn implements part of the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (the Aarhus Convention). Access to environmental information, to which the act applies, is broader in scope than access to other types of information, which is covered by the Open Administration Act. The definition of environmental information covers the state of the environment; elements such as substances, energy, noise, radiation, waste, emissions and leaks that cause or may cause pollution; policies, legislation, plans, programmes and agreements affecting the environment; reports on implementation of environmental legislation; economic analyses on environmental policy measures; and human health and safety, including the effects of pollution (Statutory Order No. 980 of 16/08/2017). The time in which authorities must handle requests for information ranges between one to two and forty workdays, depending on the complexity of the request.

The Open Administration Act requires national, regional and local authorities to communicate actively about their activities on their websites. Every four years, MEF issues an Environmental Status Report on Denmark's nature and the environment. The latest such report was issued in 2015. In November 2018, Danish authorities said they expected the next Environmental Status Report to be published in 2019.

NOVANA makes national monitoring data available to the public on environmental impacts, status and trends with regard to nature and the environment. Aarhus University publishes a yearly summary of these technical documents as a more accessible supplement.

2.6.3. Access to justice

For most of the review period, the Environment and Nature Appeal Board was an independent authority examining appeals against administrative decisions on environment, nature and spatial planning. On 1 February 2017, the board's responsibilities were split between a new Environment and Food Appeal Board for environment and nature and a separate body for spatial planning appeals. The structure mirrors the division of responsibilities between MEF and MIBFA. An Energy Appeal Board also exists.

The Environment and Food Appeal Board is now the top administrative appellate body for decisions made under MEF. Its membership consists of a president, judges nominated by courts, experts nominated by relevant non-government organisations and business associations; and lay members nominated by Parliament. The composition of the panel examining a given appeal depends on the nature of the appeal, but the president and judges are members of all panels. The president may decide on behalf of the board in cases that do not raise questions of major importance or precedence. A plaintiff unsatisfied with a board decision may appeal it through the regular court system.

In an effort to provide speedier access to justice for citizens, the average number of days taken for board decisions was reduced from 369 in 2011 to 182 in 2015 (Figure 2.3). In 2016, the progress was partly reversed because of adjustments related to relocation of the board from Copenhagen to Viborg.

Table 2.3. Access to justice by the Environment and Nature Appeal Board was expedited

Average number of days to rule on citizen complaints about authorities' decisions, 2011-16

	2011	2012	2013	2014	2015	2016	2011-16 average
Average number of days to decide on a complaint	369	333	392	190	182	232	283

Source: Environment and Nature Appeal Board reports for 2016, 2014, 2012 and 2011.

An ombudsman's office was established in 1955 as an independent legal institution under Parliament to which citizens can file complaints against decisions by public authorities. The ombudsman is elected by Parliament and must be a law graduate. The ombudsman may proffer criticism and recommend that authorities reopen cases and consider changing their decisions. Although the ombudsman cannot make decisions as such, public authorities generally act on the office's recommendations. The ombudsman has issued opinions on authorities' application of the Environmental Information Act, sometimes recommending expansion of its application in specific cases.

2.6.4. Environmental education

Danish authorities use information campaigns to raise public awareness of environmental issues. In recent years, initiatives have been taken to help schools educate children and youth on environmental issues.

The EPA offers educational material on nature on its website (Denmark, 2018[33]). The material is differentiated for all levels of basic education (grades 0 to 9). In grades 4 to 6, the focus is on spreading knowledge of different types of nature. In grades 8 and 9, more difficult concepts are introduced, such as biodiversity and trade-offs between species habitats and human activities.

A green think tank, Concito, has received support from the education ministry to develop a digital learning platform called Sustainable 2.0. It offers material on the Sustainable Development Goals, renewable energy sources, sustainable cities, climate change and consumption patterns (Concito/Klimaambassaden, 2018[34]).

The education and environment ministries and the Danish Agriculture & Food Council have jointly produced material for students on food waste that aims to raise awareness and give students practical tools to limit food waste (ME, 2018[35]).

Recommendations on environmental governance and management

Supporting the institutional framework

- Expand the use of task forces to build municipal capacity in the areas of environmental management where they face challenges, such as waste prevention.
- Further strengthen guidance to municipalities on implementation of environmental legislation to make it easier to use, as Switzerland does with its enforcement aids to cantons.

Making land use more sustainable

- Evaluate the cost-effectiveness of scaling up land acquisition and redistribution of environmentally valuable agricultural land through the MLRF.

Strengthening policy evaluation framework

- (OECD, 2017[8])Consider making socio-economic impact assessment (SEIA) mandatory for government policy decisions with a significant environmental impact, including in the context of RIA, based on the 2017 SEIA guidelines.
- Consider separately quantifying effects in other countries when conducting cost-benefit analyses of Danish environmental policies, e.g. health benefits in neighbouring countries resulting from Danish air pollution measures.

Promoting and ensuring compliance

- While respecting municipal autonomy, create a level playing field for companies by ensuring that municipalities apply compliance promotion and enforcement measures based on well-established and similar criteria; in particular, update the EPA compliance promotion and enforcement guidance documents with factual findings from the enforcement strategy and concrete examples from municipalities.

- Continue efforts to make fuller use of the Danish Environmental Administration database on environmental inspections to gain better understanding of non-compliance among companies and to inform policy making.
- Pursue efforts to simplify environmental legislation to further promote compliance and enforcement.

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Chapter 3. Towards green growth

This chapter assesses Denmark's progress in integrating environmental considerations into economic policy and promoting green growth. It analyses the use of taxation and other pricing instruments to pursue environmental objectives, and advances in eliminating environmentally harmful subsidies. The chapter also examines spending on environmental protection, investment in low-carbon energy and transport infrastructure and services, and promotion of green growth and eco-innovation as sources of growth and employment. The final section analyses inclusion of environmental issues in development co-operation programmes and export promotion.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

3.1. Introduction

Denmark's small, open economy is doing well, with robust gross domestic product (GDP) growth since 2015, although slow productivity growth remains a challenge (OECD, 2019[1]). The 5.8 million inhabitants enjoy high income levels and living standards, low unemployment rates and extensive welfare benefits, and have generally strong environmental awareness.

The country's history of ambitious environmental and energy policy goals contributed to the decoupling of greenhouse gas (GHG) and air pollutant emissions and other environmental pressures from economic activity (Chapter 1). Good progress has already been made against the target to decarbonise the economy by 2050, especially in the energy sector. The commitment to address environmental challenges and economic success associated with the export of clean technology, notably renewable energy resources, made Denmark a front runner in green growth.

This chapter assesses Denmark's progress in integrating environmental considerations into economic policy and promoting green growth, focusing on the period since 2005. It analyses the use of taxation and other pricing instruments to pursue environmental objectives, along with advances in eliminating environmentally harmful subsidies. The chapter examines spending on environmental protection, investment in low-carbon energy and transport infrastructure and services, and promotion of green growth and eco-innovation as sources of growth and employment. It also analyses the international dimension of Denmark's environmental policy, particularly the inclusion of environmental issues in development co-operation programmes and in trade.

3.2. Action framework for sustainable development and green growth

Having played a leadership role in the development of the 2030 Agenda, Denmark aims to spearhead implementation of the Sustainable Development Goals (SDGs). Its Action Plan for Implementation of the 2030 Agenda and SDGs, adopted in March 2017, includes 37 targets supported by national indicators. Progress reports are made public and sent to Parliament annually, and are to be complemented every four years by more comprehensive status reports that also cover policy measures. Denmark was among the first countries to conduct a voluntary national review on progress towards the SDGs, in 2017, and committed to conduct two more reviews by 2030 (MOF, 2017[2]). The review was supported by publication of the first indicator report, largely based on readily available data and indicators. Statistics Denmark aims to broaden the statistical base for future reports to facilitate comparison of progress with international measurement frameworks. Harmonisation of statistics is a key issue, as only one-third of the indicators are currently comparable with those of other EU and OECD countries.

Green growth ranks high on the political agenda and is anchored in strategic policy documents and cross-party political agreements. The 2009 Green Growth Agreement establishes a long-term strategy for environmental policy in the agricultural and food industries. The Energy Agreement for 2012-20 set ambitious targets to decarbonise the energy sector, which were confirmed in the Energy Agreement for 2020-24, adopted in June 2018. This includes the goal to achieve 100% green electricity by 2030 and net zero emissions economy-wide by 2050. It was complemented in 2018 by a climate and air proposal addressing emissions outside the EU Emissions Trading System (EU ETS), such as in transport and agriculture. The overarching framework to achieve a low-carbon society was already set by the 2014 Climate Change Act. Some municipalities set local low-carbon

targets and strategies. The capital city, Copenhagen, for example, aims to become carbon neutral as soon as 2025, though this target will be difficult (and more costly than expected) to achieve (Politiken, 2019[3]).

The government has recently increased the emphasis on cost-effectiveness of green growth measures, ensuring they are beneficial to employment and competitiveness, on the one hand, and environmental and climate concerns on the other. The 2018 Energy Agreement, for example, aims to expand renewables on market conditions and to reduce costly subsidies. At the same time, subsidies for some technology, as well as tax concessions to businesses, remain in place, reducing overall cost-effectiveness (Sections 3.3 and 3.5). Denmark has chosen to make significant use of flexibility mechanisms to achieve its ambitious mitigation goal for non-EU ETS sectors: land use, land-use change and forestry (LULUCF) credits and cancellation of EU ETS quotas (Chapter 1). The agricultural sector, which accounts for 20% of total GHG emissions, remains without direct regulation or taxation, which Denmark justifies because of high price competition and limited availability of cost-effective mitigation technology in the sector (Box 3.1). However, continued investment in research and cost-benefit calculations of emission reduction options in agriculture are called for, especially in view of a recent announcement by the Danish food industry that it aims to become carbon neutral by 2050 (DFAC, 2019[4]).

Social cost-benefit analysis has long been used for decision making in sectors such as energy and transport. Its use has been more limited in the environment sector, but has increased in recent years. The Ministry of Finance has published guide values to estimate the benefits of environmental improvements in such analysis, which has helped enhance transparency and consistency across studies. The ministry also increased the recommended value for statistical life to be used in cost-benefit analysis, bringing it closer to values cited in the related OECD meta-analysis (OECD, 2012[5]). As noted in Chapter 2, policy making in Denmark benefits from regular engagement of stakeholder and expert groups, such as the Environmental Economic Council, which examines environment-economy links and environmental policy efficiency, and the Climate Council, which advises on how to become a low-carbon economy by 2050. An SDG Council was established in 2018. In May 2018, the government set up a "growth team" of business leaders to develop recommendations on better framework conditions for business opportunities related to the green transition, notably regarding green energy and environmental technology and digitisation.

In early 2018, Statistics Denmark published a comprehensive report on green national accounting (SD, 2018[6]). Developed over three years, the initiative aimed at developing a green national accounting framework. The report gives an overview of recent developments and resulting environmental pressures, the state and trends of natural capital stock and the contribution of green activities to the economy. Some indicators under this framework are directly linked to the SDGs. A follow-up project with the University of Copenhagen is to further develop green national accounting, including an environment-adjusted GDP. With stable funding, this work could become the basis for a permanent green growth monitoring framework. Development of an environmental-economic macroeconomic model is also planned, to better forecast interaction between economic activity and the environment.

Box 3.1. Climate mitigation in Danish agriculture

Agriculture accounts for 20% of GHG emissions in Denmark (Chapter 1). Emissions have slightly declined since 2005, mostly through efficiency gains in production and efforts to limit nitrate pollution of water bodies. Denmark does not directly regulate agricultural emissions, citing limited availability of cost-effective mitigation technology and high price competition in the sector, as well as carbon leakage concerns.

Ex ante evaluation of the cost-effectiveness of GHG mitigation measures in agriculture revealed that between 13% and 26% of the sector's emissions could be reduced by 2030 (Dubgaard and Ståhl, 2018[7]). Converting highly organic soil, such as peatland, to nature areas was found to have by far the largest mitigation potential at relatively low cost. Other options were increased biogas production, sustainable slurry management, changes in livestock feed and the addition of chemicals to fertilisers and slurry (Table 3.1). The findings were broadly consistent with international estimates of mitigation potential in agriculture.

Costs estimates for such mitigation measures range from DKK 273 (EUR 37) to DKK 1 588 (EUR 213) per tonne of CO_2 equivalent (t CO_2 eq). This is more costly than climate action in the energy and industrial sectors, which are mostly covered by the EU ETS (the price of allowances in the EU ETS have been around EUR 20 per tonne of CO_2 since mid-2018). But it is below the estimated cost of further emission reductions in the transport sector, where taxes already impose a relatively high implicit carbon price (DEC, 2018[8]). It is important to note that most measures evaluated have considerable co-benefits on water or air quality (Table 3.1). The Danish Economic Council (2018[8]) found that marginal mitigation costs in agriculture were negative up to 0.8 MtCO_2 eq thanks to co-benefits.

Despite transport's higher mitigation cost, the government has prioritised climate action in that sector, in particular through a goal of phasing out sales of fossil fuel-based cars. Denmark has begun to expand catch crops, introduce slurry acidification and convert organic soil. However, it has decided not to pursue reduced fertiliser use as a mitigation measure, which studies had found to have great mitigation potential (MCEB, 2013[9]). Resources have been earmarked for research and development (R&D) in agriculture mitigation as well as carbon capture, use and storage (Section 3.6.1).

Table 3.1. Cost-benefit analysis of selected GHG mitigation measures in agriculture

Measure	2030 mitigation potential (t CO_2 eq)	Mitigation cost (DKK/t CO_2 eq), excluding co-benefits	Mitigation cost (DKK/t CO_2 eq), including co-benefits*	Co-benefit for water quality (tonne of reduced nitrogen leaching)	Co-benefit for air quality (tonne of reduced ammonia emissions)
Increased biogas production with improved slurry management	337 000	1 123	987	1 370	-
Stable acidification of slurry from pigs and cattle	176 000	1 132	- 94	-	3 700
More concentrated feedstuffs for dairy cows	158 000	948	948	-	-
Additional vegetable fat for young dairy stock	16 000	- 1 020	- 1 020	-	-
Nitrification inhibitors in nitrogen fertiliser	496 000	1 413	1 296	1 980	149
Nitrification inhibitors in slurry	213 000	1 506	1 225	2 398	-
Conversion of arable organogenic land (e.g. peatland) to permanent grass**	1 352 000	273	218	2 673	119
Total mitigation potential **	2 748 000				

* Based on a low-end estimate of the shadow price of reduced nitrogen leaching (DKK 25 per kg N).
** Mitigation potential includes LULUCF emissions. Excluding LULUCF, the emission potential of conversion of arable organogenic land would reach -168 000 t CO_2 eq and total mitigation potential 1.41 Mt CO_2 eq.
Source: Based on Dubgaard and Ståhl (2018[7]), *Omkostninger ved virkemidler til reduktion af landbrugets drivhusgasemissioner* (Costs of instruments for reducing agricultural greenhouse gas emissions).

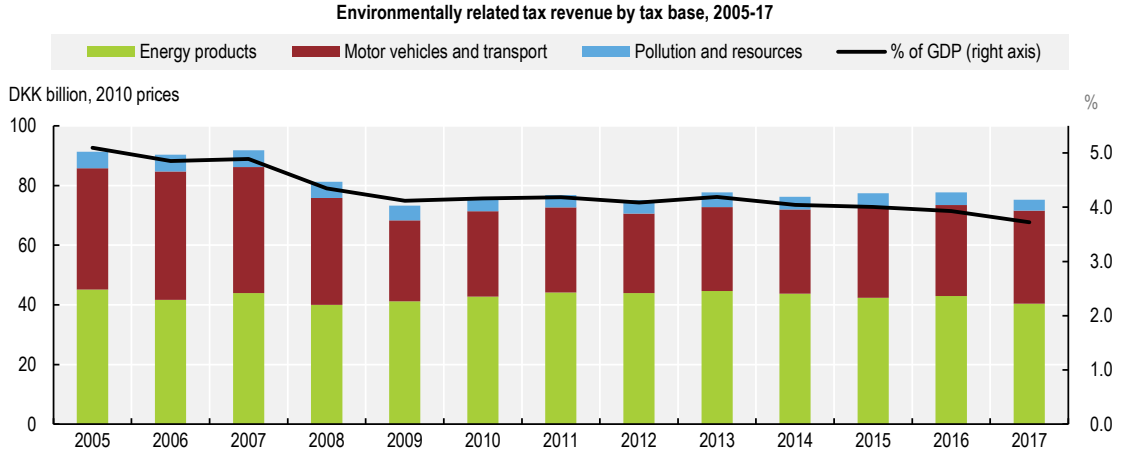
3.3. Greening the system of taxes, charges and prices

3.3.1. Overview

Denmark's public finances are strong, known for mostly close to balanced budgets and low public debt (50% of GDP in 2017; Basic statistics). The fiscal balance was in deficit during the global financial crisis and prolonged recovery, as fiscal policy supported demand, but it has improved in recent years. The government's medium-term economic plan envisages structural balance after 2020. The tax burden is high by international comparison. Denmark ranked second among OECD countries for tax/GDP ratio in 2017 (46%, compared with the OECD average of 34%), due in part to high personal income tax. The government aims to lower the tax burden, however. Several tax cuts have contributed to a 2.5 percentage point decline in the tax/GDP ratio since 2014. Nearly three-quarters of tax revenue is collected by the central government and the rest by local governments (OECD, 2018[10]).

Denmark has a long history of applying environmentally related taxes, being among the front-runners in integrating environmental considerations into its tax system. Many taxes align closely with the estimated external cost of production or consumption activities. Environmentally related tax revenue has been declining, though at 3.7% of GDP in 2017 it is still the highest value among OECD countries and more than twice the OECD average (1.6% of GDP in 2016) (OECD, 2018[11]). Revenue declined considerably during the 2008-09 financial crisis, mostly because vehicle tax revenue fell due to deductions for fuel-efficient cars introduced in 2007; the level stayed relatively constant in the following years (Figure 3.1). As in most OECD countries, energy-related taxes account for the largest share of tax revenue. Yet Denmark differs from other countries in its large taxes on vehicles. Taxes on pollution and natural resource use account for a small share of total green tax revenue, although the level is higher than in many other OECD countries.

Figure 3.1. Environmentally related tax revenue has decreased slightly



Source: OECD (2018), "Environmental policy instruments", *OECD Environment Statistics* (database); EU (2018), National Tax List (NTLs); Statistics Denmark (2019), "Green economy: Environmental taxes", *StatBank* (database).

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3.3.2. Taxes on energy products and carbon pricing

Denmark has a long history of energy taxation and carbon pricing, being one of the first countries to introduce a carbon tax (1992) and pioneering CO_2 emission trading for the power sector (2000). Taxes on energy products accounted for 2.2% of GDP in 2016, one of the highest levels in the OECD (OECD, 2018[11]). The following are the main taxes on the use of energy products (OECD, 2018[12]):

- *Energy duty* (52% of energy-related tax revenue in 2017): applies to fossil fuel use (oil products, natural gas, coal, coke and fossil waste) at rates that depend on the fuel's energy content and on user category. In line with the recommendation in the 2007 OECD Environmental Performance Review of Denmark, rates are now indexed for inflation.
- *CO_2 tax* (8%): applies to fossil fuel use (oil products, natural gas, coal and coke), at rates that depend on the fuel's carbon content. Rates are the same for most users, at DKK 173/t CO_2 (EUR 23) in 2018, and indexed for inflation.
- *Electricity tax* (28%): is levied on electricity output (per MWh). Tax rates vary widely by purpose and user group. Fuels used to generate electricity are not taxed.

Other taxes on energy use include a tax on fossil waste[1] and taxes on emission of SO_X (for energy products containing more than 0.05% sulphur) and NO_X from fuel combustion (Section 3.3.4). A Public Service Obligation (PSO) tax on electricity use was introduced in 2012 to generate resources for renewables subsidies, but it was decided in 2016 to phase it out over 2017-21.

Taxes on energy products

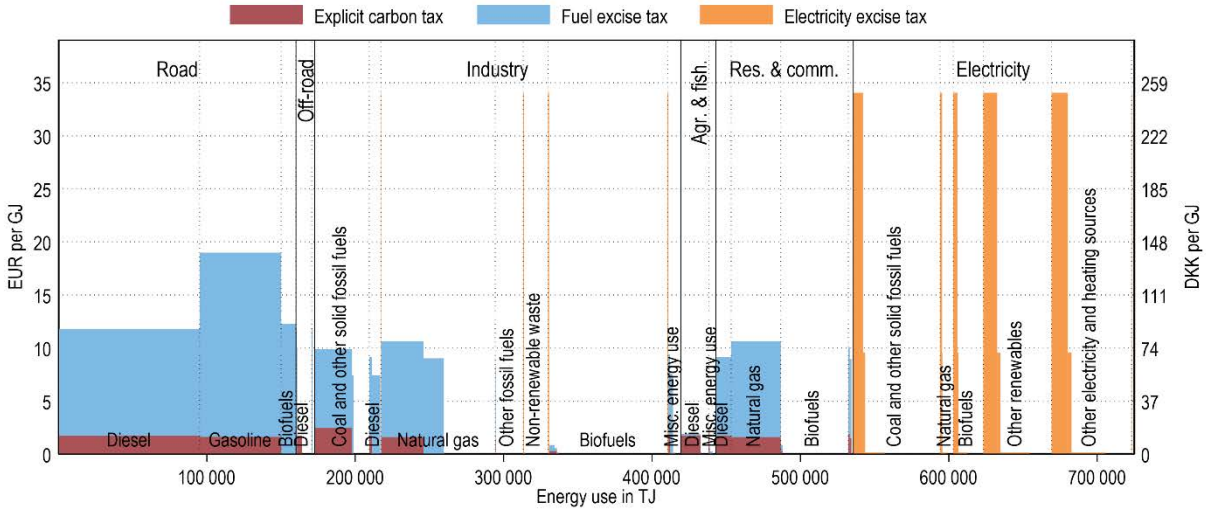
The tax burden resulting from energy taxes varies widely across fuels, users and purposes. As in most OECD countries, transport fuels are taxed at the highest effective rate (Figure 3.2). Yet Denmark also has one of the OECD's highest effective tax rates on energy use in non-road sectors (OECD, 2018[13]). This is explained by relatively high tax rates on electricity and other energy use in the residential and commercial sectors. Industry and agriculture face a considerably lower tax burden due to reductions and exemptions. The electricity tax for industry (i.e. production processes), for example, was set at DKK 4 (EUR 0.54) per MWh in 2019, just above the EU minimum and about 200 times below the ordinary electricity tax applicable to households (DKK 884 or EUR 119/MWh). The large disparity in energy tax rates creates unequal incentives for energy savings, and is not justified from an environmental perspective. The energy tax burden on industry (e.g. energy tax revenue as a share of industry's gross value added) declined from 1.5% in 2004 to 0.8% in 2016 (MIBFA, 2018[14]), increasing the scope for adjustment.

Electricity taxes for households are the highest in the EU (EC, 2018[15]). While historically high taxes have encouraged power savings, their justification diminishes as power generation becomes cleaner. They also interfere with the cap in the EU ETS[2] and discourage switching towards efficient solutions for electric heating (e.g. heat pumps and electric boilers) or electric vehicles, and create incentives for self-generation of power (e.g. with individual rooftop photovoltaic systems), even where socio-economically inefficient (IEA, 2017[16]). The government has taken steps to address this issue. It has reduced the electricity tax for heating (both for households and businesses) to DKK 259 (EUR 35) per MWh and plans to differentiate the tax on electricity used for electric vehicles. The phase-out of the PSO levy will reduce overall electricity prices and the 2018 Energy Agreement announced a gradual reduction in the standard electricity tax to

DKK 774/MWh (EUR 104/MWh) by 2025. This will help increase the attractiveness of electric heating and mobility vis-à-vis fossil fuel- and biomass-based solutions. Unfortunately, the Energy Agreement also lowers the rate for some businesses to the minimum set for industrial processes, contributing to disparity among users. The change aims to equalise rates among businesses.

Figure 3.2. Effective energy tax rates are highest in the road sector

Effective tax rates on energy use, by sector and by energy category



Note: Tax rates applicable on 1 July 2018. Energy use data are for 2016 and adapted from IEA (2018), *World Energy Statistics and Balances*. Excludes the PSO tax.
Source: OECD (2019), *Taxing Energy Use 2019*.

An open question is how to finance the reforms. Energy taxes are an important source of budget revenue, accounting for 5% of total tax revenue in 2016. Energy-related tax revenue has fallen by 11% since 2005 in real terms. The decline was driven by reductions in revenue from the CO_2 tax and the energy duty on petrol and natural gas, which in turn reflected declining consumption of fossil fuels and associated CO_2 emissions. Revenue will likely continue to fall with the projected decline in fossil fuel consumption, the phase-out of the PSO tax and reductions in the electricity tax. The government is considering temporarily increasing energy taxes or establishing a new temporary energy tax to finance the shortfall. Reducing the gap between industrial processes, heating purposes and other uses and/or taxing biomass could help in this respect.

Solid biomass, which is exempt from the energy duty and CO_2 tax, has gained in importance as a source for domestic and district heating. It use has more than doubled since 2005 and it accounted for 58% of renewables in 2017 (IEA, 2019[17]). While the use of biomass helps in meeting renewables targets, the assumption that it is carbon neutral from a lifecycle perspective has increasingly been challenged in the scientific literature (OECD, 2018[18]). In Denmark, 43% of consumed biomass is imported, primarily from Estonia and Latvia, making it even more difficult trace the fuel's sustainability and carbon neutrality. The burning of biomass also creates significant air pollution (Chapter 1). The favourable tax treatment for biomass should therefore be reconsidered. Energy utilities have put in place

a voluntary programme to ensure sustainable use of biomass, which includes sustainable management of the forests from which the biomass is derived.

Petrol is taxed significantly more heavily than diesel, at DKK 4.561 (EUR 0.61) per litre compared to DKK 3.104 (EUR 0.42) per litre of diesel. The tax gap between the two fuels is one of the largest in the OECD and increased over 2012-15. This is regrettable from an environmental perspective, as diesel combustion emits more CO_2 and local air pollutants than an equivalent volume of petrol. In addition, a litre of diesel normally allows more kilometres to be driven, meaning the tax on it should be higher to internalise driving-related externalities (Harding, 2014[19]). Road transport fuels are taxed at an effective rate (i.e. when considering both energy taxes and the carbon tax) that is comparable to average OECD levels but lower than in other Scandinavian countries and neighbouring Germany (OECD, 2018[13]).

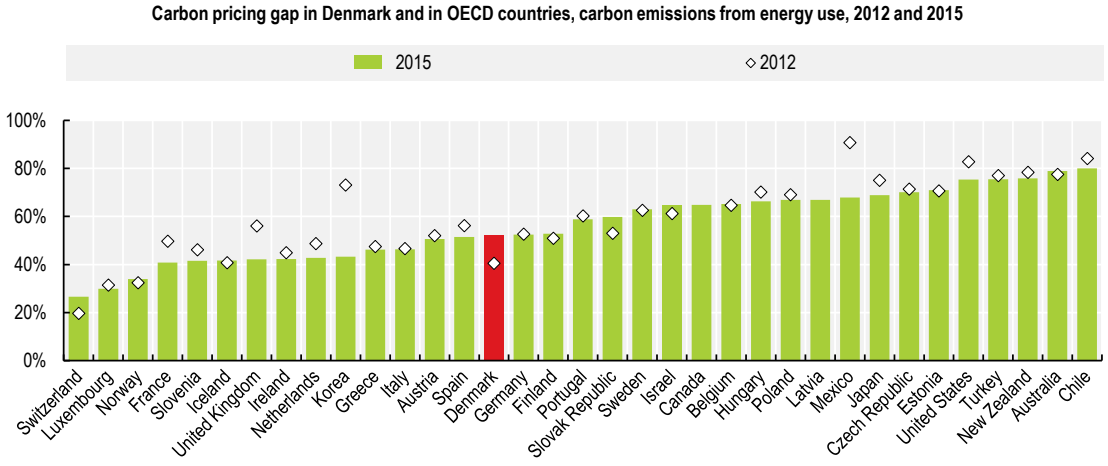
To address the diesel-petrol gap, Denmark levies an annual countervailing charge on diesel cars (Section 3.3.3). The rationale is that a direct increase in diesel tax rates might encourage fuel tourism to neighbouring countries. However, as an annual tax that is not linked to vehicle use, it is less efficient way of addressing externalities. In addition, end-user prices for diesel are lower than in Sweden and Norway, although indeed higher than in Germany (IEA, 2018[20]). In any case, the countervailing charge failed to balance the lower diesel tax: both the sale of diesel vehicles and diesel consumption increased, with the share of diesel cars in the passenger fleet jumping from 10% to 31% over 2005-17 (DRD, 2018[21]). Denmark would benefit from phasing out the reduced energy duty for diesel, especially if it co-ordinated with similar moves in neighbouring countries.

Pricing carbon emissions from energy use

The carbon tax was introduced in 1992 for households and space heating in industry and has since been increased and extended to other uses. In 2008, Denmark raised the tax from DKK 25 to DKK 150 (which was the expected price of allowances in the EU ETS) and later indexed it to inflation. In 2018, the rate was DKK 173.2/tCO_2 (EUR 23/tCO_2), lower than in neighbouring Sweden, Norway and Finland. It should be noted, however, that Denmark levies higher excise taxes on some energy uses, such as transport fuels and residential energy use, which raises the implicit price of carbon. As explained above, energy excise duties – and thus the implicit price of carbon – vary significantly by user group, creating unequal incentives for CO_2 emission reductions. In addition, industrial processes benefit from a reduction of the CO_2 tax (IEA, 2017[16]).

In addition to putting a price on carbon via taxes, Denmark participates in the EU ETS. In 2017, 34% of Danish GHG emissions were subject to carbon pricing through this system. EU ETS installations are exempt from the carbon tax, or receive a full refund, to avoid double taxation; the exceptions are incinerators (Chapter 4) and heat inputs for district heating plants. The OECD estimates that, accounting for energy taxes and the EU ETS, 78% of CO_2 emissions from energy use in Denmark faced a price signal in 2015, albeit at a relatively low level (the remaining emissions largely stem from combustion of biomass, which is not taxed). Only 32% of CO_2 emissions faced a price above EUR 30/tCO_2 in 2015, which is a low-end estimate of climate damage. In contrast to a generally rising price signal in the OECD, the share of CO_2 emissions priced at or above EUR 30 in Denmark has dropped from 52% in 2012 (OECD, 2018[18]). This is likely due to higher (untaxed) biomass consumption and lower energy tax rates for industry. As a result, the economy-wide carbon pricing gap increased from 40% in 2012 to 52% in 2015 (Figure 3.3).

Figure 3.3. Denmark ranks about average in pricing of carbon emissions from energy use



Note: The carbon pricing gap shows the extent to which countries price carbon emissions from energy use below the benchmark value, by measuring the difference between the benchmark and the actual rate for every percentile, and summing all positive differences. The gap is measured as a percentage. If the effective carbon rate on all emissions was at least as high as the benchmark value, the gap would be zero, and if the effective carbon rate was zero throughout, the gap would be 100%. EUR 30 is a low-end estimate of the climate damage from one tonne of CO_2 emissions.
Source: OECD (2018), *Effective Carbon Rates*: *Pricing Carbon Emissions Through Taxes and Emissions Trading.*

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3.3.3. Transport taxes and charges

Vehicle taxes

Vehicle taxes consist of a one-off duty on purchase (the registration tax), an annual ownership duty (commonly called the green owner tax)[3] and the countervailing charge for diesel vehicles. Added to this is a tax on car insurance premiums. While taxes for passenger cars have been reduced several times in recent years, they remain high by international comparison, mostly due to a high registration tax. They also appear high with respect to transport-related externalities (DEC, 2018[8]). Taxation of lorries, buses and trucks, by contrast, is relatively light.

High vehicle taxes discourage car purchases, resulting in a relatively low vehicle ownership rate and slow fleet renewal. The average passenger car is 8.9 years old, above the EU average of 7.4 years (EEA, 2018[22]). At the same time, the high registration tax (which is based on vehicle value) has encouraged purchases of cheaper vehicles, which tend to be small and more fuel efficient. In addition, both the registration tax and the green owner tax are linked to fuel efficiency.[4] This combination had a significant impact on consumer choice, with higher sales of smaller and more energy-efficient cars that emit less CO_2 per kilometre. Average emissions from new cars have been below the EU average in the past decade (IEA, 2018[23]). The exemption of lorries from the registration tax and reduced annual tax rates on cars and vans used for commercial purposes are not justified from an environmental perspective and should be reconsidered.

Shifting the tax burden from car ownership to the use of vehicles and roads would enhance transport taxation efficiency (OECD, 2019[24]). Some progress has been made in this direction. In 2017, the registration tax was reduced to 85% of vehicle list price for the first DKK 185 000 (about EUR 25 000) from 105% of list price for the first DKK 106 000 (about EUR 14 000), while the annual vehicle tax was increased. The remainder is taxed at 150%, still high by international comparison. As the reductions were not compensated by

measures targeting the externalities of car use, care must be taken to avoid cutting average car prices to the point of stimulating car sales and outweighing emission reduction benefits. The number of cars on the streets has grown continuously since 2010 (Chapter 1).

The countervailing charge that diesel car owners must pay aims to offset the difference in energy duty between diesel and petrol (MT, 2015[25]) but has not slowed the increase in diesel car sales. For normal diesel cars, the countervailing charge is calculated as the estimated tax saving from using diesel instead of petrol for 22 000 km annually. In addition, since 2010, a surcharge of DKK 1 000 (EUR 134) has been applied to diesel cars and new commercial vehicles (registered after March 2009) not fitted with particulate filters. Diesel buses pay a fixed countervailing charge of DKK 1 230 (EUR 165) per year and trucks and tractors are exempt. This exemption is not justified from an environmental perspective and should be reconsidered. Overall, taxation of trucks fails to internalise their external environmental costs.

To promote sales of electric and hydrogen vehicles, they were exempt from the registration and green owner taxes until 2015. The government aimed to phase in a registration tax for such cars (20% in 2016, 40% in 2017, 65% in 2018, 90% in 2019 and 100% in 2020), but this, coinciding with a general decrease in the registration tax, paralysed electric car sales (IEA, 2018[23]). The government thus decided to maintain the registration tax for electric vehicles at 20% for two additional years or until a threshold of 5 000 new registrations was reached. More recently, as part of the climate and air proposal, the government suggested imposing a registration tax for electric vehicles and hybrids with a list price of less than DKK 400 000 (EUR 54 000) in 2019 and 2020. This measure was adopted in late 2018 (see also Section 3.5.3).

Road and congestion pricing

Heavy vehicles and trucks with a permissible total weight of over 12 tonnes have to pay a road tax (Eurovignette) on motorways.[5] Coaches are exempt. In addition, tolls apply on two major bridges: the Great Belt and Øresund. As part of the political agreement on lowering the registration tax, the government agreed to examine possibilities of introducing period-based tolls for passenger and vans from 2020 (MOT, 2017[26]). No details on implementation of such tolls have been released to date. Previous attempts to better internalise external environmental costs (e.g. through tolls per kilometre driven on certain roads) have been abandoned because they were considered very costly.

Congestion pricing is not applied. Introducing dynamic congestion pricing, where tolls can be adjusted according to traffic conditions, in the most affected cities would reduce pollution, enhance infrastructure use and generate revenue. Plans to introduce a congestion tax in the capital, the city most affected by congestion, were replaced by an air quality protection plan to reduce PM_{10} and NO_2 pollution. In February 2019, the government set up a consultative commission to study ways to reduce CO_2 emissions from transport, giving it a mandate to consider road pricing and road tolls, among other measures, as alternative sources of revenue (MOF, 2019[27]).

Company cars and commuting expenses

As in most OECD countries, the employee benefit of being able to use a company-owned car (including for private purposes) is taxed less than cash wages. Harding (2014[28]) estimated that this favourable tax treatment created an annual subsidy of EUR 1 800 per company car, causing a tax revenue shortfall of about EUR 300 million in 2012 (compared to EUR 3 billion in revenue from vehicle-related taxes that year). Denmark's system of

company car taxation provides no incentive to choose efficient or less polluting vehicles. Company cars increase an employee's annual taxable income by 25% of the vehicle's listed value, irrespective of car type (unlike in Belgium, for example, which differentiates rates by CO_2 emissions and fuel type). In a positive step, the government's climate and air proposal would make it cheaper to choose electric cars for use as company cars.

Employees who commute more than 24 km a day can deduct expenses related to commuting from their taxable income. The amount of deduction is calculated by applying a set rate to the distance travelled between home and workplace; the farther the employee lives from the workplace, the lower the deduction per kilometre travelled. There is no differentiation between forms of transport (unlike in Switzerland, for example, which allows deductions for private car use only in limited cases, a lump sum deduction for biking, and full deduction of public transport costs, providing an incentive to favour public transport and biking). Public transport costs paid by the employer are not treated as taxable income to the employee, increasing the attractiveness of public transport relative to other forms of commuting (including private car use), yet comparatively penalising lower-cost forms such as walking, biking and carpooling (Harding, 2014[28]).

3.3.4. Other economic instruments to limit pollution and resource use

Air pollutants

A tax on SO_X emissions for products containing more than 0.05% sulphur was introduced in the mid-1990s. A tax on NO_X emissions was introduced at DKK 5/kg in 2010. In 2012, the NO_X tax was raised to DKK 25/kg (and the limit value for mandatory measurement reduced from 30 MW to 10 MW to cover more producers), but it was reduced back to DKK 5/kg in 2015. Both the SO_X and NO_X tax rates are below the respective external costs of these pollutants as acknowledged in the guideline values for cost-benefit analysis published by the Ministry of Environment and Food (MEF) (Andersen, 2018[29]). There is no specific tax rate for particulate matter or volatile organic compounds.

Waste

Denmark applies taxes on waste landfilling and incineration. The landfill tax, introduced in 1987, was increased in 2015 to DKK 475 per tonne from DKK 160/tonne in 2012-14 (MT, 2015[25]). The tax has helped reduce landfilling but had only limited effect on recycling rates. The incineration tax was converted in 2009 from a weight-based tax to one based on energy and CO_2 content. The new system aims at providing a stronger incentive to recycle the most energy-intensive waste, such as plastics (Chapter 4). The tax is a combined input-output tax, charged at DKK 26.5 per GJ according to the energy content in the input waste and DKK 19.8 per GJ for heat output. Waste from biomass and processing of meat waste are exempted. An exemption for hazardous waste was abolished in 2010. Waste incineration for power and heat generation represents a large share of waste treatment in Denmark. Denmark also applies a volume-based packaging waste tax on several types of beverage containers that are not part of the deposit-return system, and on bags and disposable tableware (Chapter 4). A weight-based packaging tax was removed in 2014.

Agricultural products

Denmark is one of the few countries taxing pesticides. In 2013, the pesticide tax, which was introduced in 1996, was redesigned from a value-based tax to a quantity-based tax that

varies depending on human health hazard classification and the environmental impact of the pesticide: products with higher persistence, bioaccumulation or leaching to groundwater face higher rates. The generally higher tax rates and revenue were reimbursed to the agricultural sector (which accounts for more than 90% of pesticide use) through a reduction in the land value tax (GBE, 2014[30]). The change was made in a bid to reduce the pesticide load (a risk indicator) by 40% by 2015 from the 2011 level. Pesticide sales dropped significantly following the reform, partly because farmers stockpiled pesticides ahead of the reform (Chapter 5) (Eurostat, 2018[31]).

A tax on mineral phosphorus added to animal feed was introduced in 2005 at a rate of DKK 4 per kg of phosphorus to encourage a switch to phytase so as to reduce the saturation of soil with phosphorus. Mineral phosphate use in animal feed has fallen by about 15% since the introduction of the tax, and phytase use has increased. The tax is thus believed to have improved overall efficiency in the use of animal feed (Andersen, 2016[32]). A new phosphorus regulation introduced in 2017 allows efficient feeding, for example using high doses of phytase, to meet requirements on phosphorous reductions. It has resulted in a stronger incentive to increase phytase and reduce mineral phosphorus use than the tax. To prevent double regulation, the tax was to be withdrawn in July 2019.

Denmark pioneered construction of nutrient accounts at farm level. Agricultural nitrogen use has been partly regulated by a quota system, with allowable nitrogen consumption based on crop selection and soil type, among other criteria. Denmark recently adopted a new political agreement on more targeted regulation for agricultural nitrogen emissions, with targets based on geographical differences in watershed vulnerability and the soil's ability to retain nitrogen (Chapter 1). The nutrient accounting system facilitates this new regulation paradigm. Since 2018, the nutrient accounting system has also been used to administer maximum allowable levels of phosphorus consumption at farm level.

Water

Denmark does not tax water resource abstraction but applies a tax on piped water at a rate of DKK 6.5 (EUR 0.9) per cubic metre. Most companies are exempt from the water tax (EEC, 2017[33]), implying that industry is in some sense cross-subsidised by households, which indeed face very high end-user prices (Section 3.5). Water supply plants must pay the tax on a minimum of 90% of water pumped, so if the plant has losses of more than 10%, it still pays on the balance of water lost. This rule, referred to as the water loss tax, creates an incentive for water companies to reduce leakage.

A wastewater charge applies to all direct discharges from sources including industry, municipal wastewater treatment plants and individual households in the countryside. The tax is proportional to the pollution load and applies to nitrogen (DKK 30/kg), phosphorus (DKK 165/kg) and organic material (DKK 16.50/kg). The rate is uniform nationwide, whatever the quality objective or the diluting capacity of receiving waters. Utilities pass on the cost to households; direct dischargers pay it directly to authorities. Some industrial sectors, including fish processing, benefit from reductions of between 70% and 80% in this tax liability. A small part (less than 5%) of the revenue raised is earmarked for government mapping of groundwater and municipal action planning.

3.4. Support to fossil fuel consumption and agriculture

3.4.1. Fossil fuel subsidies

The Ministry of Taxation reported total tax expenditure related to environment, energy and vehicles was DKK 12.1 billion (EUR 1.6 billion), or 25% of total tax expenditure in 2017 (MOT, 2018[34]). Table 3.2 provides a full breakdown of the expenditure. Several of the measures involved qualify as fossil fuel support: for instance, the exemption of agriculture from the energy duty; tax exemptions or deductions for shipping, aircraft and companies with heavy processes not covered by the EU ETS; and the lower diesel ownership tax for lorries, buses and tractors (for which there is no countervailing charge). The OECD Inventory of Fossil Fuel Support estimated total support to fossil fuel consumption at DKK 1.5 billion in 2017 (OECD, 2019[35]).[6] This equals 0.15% of total tax revenue, below the OECD average support to fossil fuel consumption (0.5% of total tax revenue in 2016) (OECD, 2019[35]).

Table 3.2. Tax expenditure for the environment, energy and vehicles

Measures relating to environmental, energy and car taxes, 2017

	DKK million
Environment and energy	
Exemption from electricity tax for self-generation (e.g. from solar cells)	365
Exemption from energy duty for biomass	4 300
Exemption from energy duty and from CO_2, NO_x and SO_2 tax on fuel used for shipping (ships, ferries and fisheries)*	1 050
Exemption from energy, NO_x and SO_x tax on aircraft fuels*	110
Exemption from energy duty and electricity tax for train operations*	650
Deductibility of CO_2 tax for companies with heavy processes not covered by the EU's CO_2 quota system*	65
Deductibility of SO_2 tax for companies with particularly high energy consumption*	10
Reduction in wastewater tax for large companies	10
Lower electricity tax for shore power to ships	15
Reductions and exemptions for energy duty for agriculture*	1 200
Ceilings on tax rates on certain industrial GHGs	5
Cars, etc.	
Lower diesel tax for lorries, buses, etc.*	1 350
Deductibility of registration tax for certain types of security equipment	2 750
Phasing in of electric cars in the registration tax	100
Phasing in of particle filter supplement for old vans	105
Exemption for private use allowance for old vans	30
Total	**12 115**

*Qualifies as fossil fuel support.
Source: MOT (2018), *Tax Expenses: Total Level at the End of 2017*.

Until 2014, the OECD inventory listed another measure: the reduced energy duty for combined heat and power (CHP) generation. The Ministry of Taxation then decided to cease regarding this measure as tax expenditure.[7] District heating customers pay a reduced energy duty for heat delivered from a CHP plant to discourage them from using other heating fuel, such as fuel oil. Tax revenue forgone due to this reduction has declined over time due to the increasing share of non-fossil heating sources (e.g. wood, straw), which are not subject to the energy duty. In 2014, revenue forgone from this measure reached DKK 5.7 billion (EUR 0.8 billion) (OECD, 2019[35]).

3.4.2. Agricultural support

Arable land and cropland take up more than half of total land area, the highest share among OECD countries (OECD, 2019[36]). This puts pressure on the environment, especially where farming takes place on peatland or close to sensitive natural areas and water bodies. Farmers receive agricultural support under the EU Common Agricultural Policy (CAP), mainly as direct payments for income support. The payments comprise a basic payment and additional payments, notably the so-called green payment provided if farmers diversify crops, maintain permanent grasslands and keep 5% of their land as ecological focus areas.[8] Farmers also receive support through the Rural Development Programme (RDP), co-financed by Denmark and the EU, which finances individual projects on farms and/or activities in rural areas on the basis of economic, environmental or territorial priorities. Denmark has taken advantage of a flexibility mechanism to transfer part of the EU funds allocated to its farmers through direct payments into the RDP instead.[9]

Denmark built its RDP for 2014-20 around four focus areas: growth and competitiveness; organic farming; nature, environment and climate; and rural development. The organic farming and nature, environment and climate components received by far the largest volume in 2015-19 (Table 3.3). Such funding has supported expansion of organic farming (Chapter 1). Overall, three-quarters of payments have an environment-related objective, which represents DKK 1.1 billion (EUR 148 million) per year. There has been a relative shift in the RDP from supporting investment at farm level to organic farming and activities addressing nutrient pollution of the aquatic environment. The shift is partly to support the targeted approach to nitrogen regulation of farmers (Chapter 1). Spending on biodiversity purposes is more limited.

Subsiding peatland conversion

Conversion of peatland to wetlands or permanent grassland has considerable climate mitigation potential due to lower decomposition of soil carbon, with a potential to reduce agricultural GHG emission by about 15% (Dubgaard and Ståhl, 2018[7]). However, EU policies limit this potential, as farmers lose income support under the CAP when agricultural peatland is converted to nature areas. Moreover, the EU 2030 Climate and Energy Framework caps how much member states can use carbon sequestration to meet their reduction targets for non-EU ETS sectors.

Under the RDP, Denmark subsidises farmers for conversion of peatland into permanent nature areas. DKK 65 million (EUR 9 million) was allocated to this purpose per year for 2016-19 (see "Rewetting of low-lying areas" in Table 3.3). In addition, Denmark set up a Multifunctional Land Redistribution Fund (MLRF) with a budget of EUR 20 million as part of the drought package for agriculture from 2018. The fund's aim was to acquire and redistribute agricultural land where farming had a significant environmental impact and convert it to natural areas or grassland; examples include peatland and soil close to ammonia-sensitive nature areas or close to drinking water boreholes. In February 2019, Denmark's two main environmental and agricultural interest groups jointly recommended increasing the MLRF by at least EUR 130 million to buy environmentally valuable agricultural land so as to support the target of achieving net zero emissions by 2050 and deliver co-benefits for biodiversity, water and air quality, and climate adaptation (DN and DFAC, 2019[37]).

Table 3.3. Environmental components of the Danish Rural Development Programme

Planned spending with environmental objectives under the Danish Rural Development Programme, 2015-19, DKK million

Payment objective	2015	2016	2017	2018	2019*	2015-19 average	Environmental objectives, average 2015-19
Growth and competitiveness	**380**	**472**	**300**	**0**	**272**	**285**	**24****
Support for investments at farms	300	392	300	0	272	253	24**
Development, demonstration and dissemination projects (mainly in the environmental area)	80	80	0	0	0	32	0**
Organic farming	**970**	**240.5**	**57.4**	**222.2**	**832.8**	**465**	**436**
Support for technology investments at organic farms	60	41	0	0	0	20	-
Organic farming (support per hectare)	870	199.5	57.4	222.2	832.8	436	436
Organic promotion, network and export activities	40	0	0	0	0	8	-
Nature, environment and climate	**567**	**515**	**566**	**679**	**909**	**644**	**644**
Nature	363	250	232	232	297	274	274
Grasslands and nature areas	197	130	190	180	243	188	188
Natura 2000 projects (land management, facilitation and planning)	51	35	0	30	27	27	27
Natura 2000, compensation to landowners	43	0	0	0	0	9	9
Rewetting of Natura 2000 areas	0	30	20	0	0	10	10
Natura 2000 forest	42	25	22	22	23	27	27
Connecting nature areas	0	0	0	0	4	1	1
Hedges	20	10	0	0	0	6	6
Annex IV species (EU Habitats Directive)	0	5	0	0	0	1	1
Sustainable forest	10	15	0	0	0	5	5
Aquatic environment	204	265	324	447	612	370	370
Wetlands targeting nitrogen	78	186	110	153	250	155	155
Wetlands targeting phosphorus	14	14	14	14	14	14	14
Wetlands (additional)	0	0	100	100	100	60	60
Mini-wetlands	0	0	0	50	115	33	33
Mandatory buffer strips along rivers and lakes	77	0	0	0	0	15	15
Rewetting of low-lying areas	0	65	65	65	65	52	52
Reserve for targeted regulation	0	0	0	0	33	7	7
Afforestation (private)	35	0	35	65	35	34	34
Rural development	**94.2**	**90.3**	**63**	**63**	**63**	**75**	-
Local action groups	94.2	90.3	63	63	63	75	-
Total spending in RDP	**2 011**	**1 318**	**976**	**964**	**2 077**	**1 468**	**-**
Total spending with environmental objectives	**1 462**	**735**	**675**	**901**	**1 755**	**1 105**	**-**
Share of spending with environmental objectives	73%	56%	69%	93%	84%	75%	-

* Estimates are used for 2019.
** Part of the payments under the growth and competitiveness focus area is reserved for green investment: in 2015 DKK 25 million, in 2016 DKK 20 million, in 2017 DKK 62 million and in 2019 DKK 13 million.
Source: Country submission.

As this proposal requires substantial public funding, Denmark should evaluate the pilot phase before scaling up the fund. In the medium term, it should seek opportunities for complementing public funding with private resources to finance peat conversion subsidies or land acquisition under the MLRF. In addition to philanthropic payments, this could be

achieved by using peatland as carbon credits that could be purchased by parties that must offset their GHG emissions through voluntary or compliance markets.

3.5. Investing in the environment to promote green growth

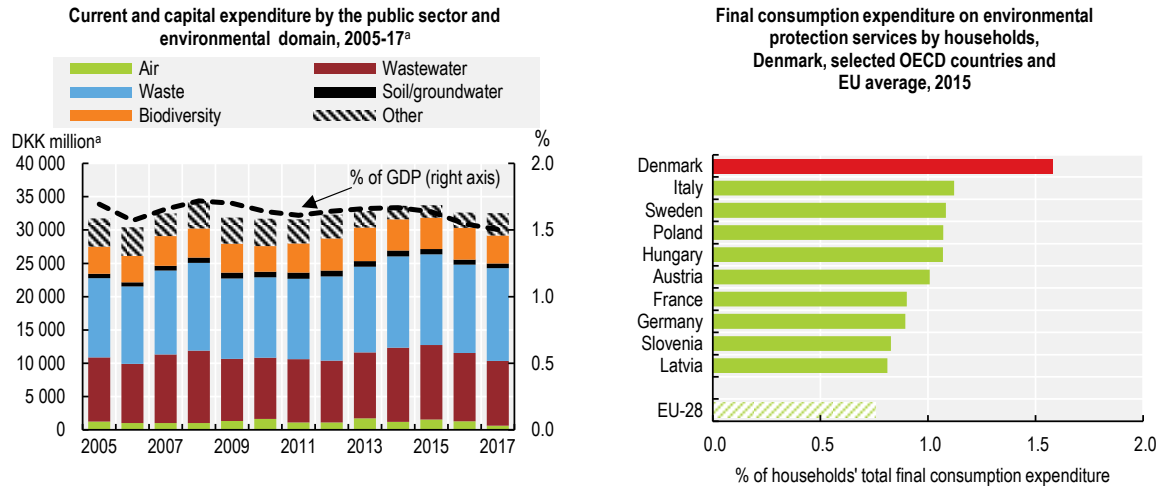
Infrastructure is a key element of any green growth strategy, with significant opportunity to improve environmental performance, boost economic growth and ensure resiliency to climate change. Denmark has modern and generally high-quality infrastructure. The World Economic Forum Global Competitiveness Report found the quality of Denmark's infrastructure to be better than the European and North American averages (WEF, 2017[38]). Compared to its European peers, Denmark scores high with respect to road, port and air infrastructure, and in the mid-range for rail infrastructure (EC, 2018[39]). The latter is reflected in the fact that Denmark has one of the lowest shares of rail transport in inland freight in the EU (Chapter 1). It has considerable transit freight transport on its rail system: about 80% of the freight transported on its railways is in transit.

The government has set up funds and earmarked resources for the green economy transition. For example, the Green Investment Fund was established in 2014 to co-finance commercially viable projects with a positive environmental impact. The state capital contribution was DKK 80 million (EUR 10.7 million), with a state-guaranteed lending limit of DKK 2 billion (EUR 268 million). The latter can be increased to DKK 5 billion (EUR 671 million) and the capital contribution to DKK 200 million (EUR 27 million). While most projects supported have concerned renewables or energy efficiency, the fund has more recently also supported bio-economy projects (e.g. production of alternative protein). The fund's performance has not yet been evaluated. The Climate Investment Fund was established to support initiatives promoting Danish investment in developing and emerging economies' green transitions (Section 3.7.2). The 2018 Energy Agreement earmarked new funding to support renewables development and energy efficiency, and the climate and air proposal announced new funding for mitigation options in agriculture and transport.

3.5.1. Expenditure for environmental protection

Public environmental protection expenditure averaged around DKK 30 billion (EUR 4 billion) over the past decade.[10] As in most OECD countries, expenditure is mostly directed towards waste management and wastewater treatment (Figure 3.4), provided by public corporations. General government expenditure mainly targets biodiversity and landscape protection, air and climate, as well soil and water protection. With a decline in expenditure on wastewater management, total public environmental protection expenditure was DKK 32.8 billion in 2017 (EUR 4.4 billion), or 1.5% of GDP, lower than in previous years (Figure 3.4).

Figure 3.4. Environmental expenditure remains relatively constant



a) Public sector includes public corporations. Data expressed at constant 2017 prices.
Source: Statistics Denmark (2018), "Public sector environmental protection: Environmental-economic accounts", *StatBank* (database); Eurostat (2019), "Final consumption expenditure on environmental protection services by institutional sector", *Environmental expenditure* (database).

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Household expenditure on environmental protection services is the highest in the EU at 1.6% of total final consumption expenditure as of 2016 (Figure 3.4). This reflects high consumer tariffs for environmental services such as waste and wastewater treatment. These, in turn, may reflect high service quality and full cost recovery, but also inefficiency in service provision. In the waste sector, for example, waste collection costs decreased as most municipalities outsourced services. Now, however, municipalities increasingly want to go back to direct management and do not have to bid for competition with private companies, which does not help improve efficiency (Chapter 4).

3.5.2. Investment in renewables and energy efficiency

Renewable energy resources

Denmark has experienced a boom in renewables over the last decade: they now account for around one-third of primary energy supply and almost two-thirds of electricity generation (Chapter 1). This growth, which was particularly strong for wind and biomass, has been driven by strong and broad political will at the local and national levels, targeted support policies and community-based engagement (IEA, 2017[16]). The main supporting policies include direct subsidies (a feed-in premium system), taxation (including exemptions of biomass from various energy taxes), subsidised grid connection and balancing costs, and reinforcement of the grid to connect plants running on renewables. Denmark also has used several funding pools, including for renewables in district heating (geothermal energy and large heat pumps) in 2012-15, and in processing in 2013-20 (IEA, 2017[16]). The share of renewables in energy demand doubled over the past decade to reach 35% in 2017 (Chapter 1), putting Denmark on track to reach its goal of meeting half of energy demand with renewables by 2030.

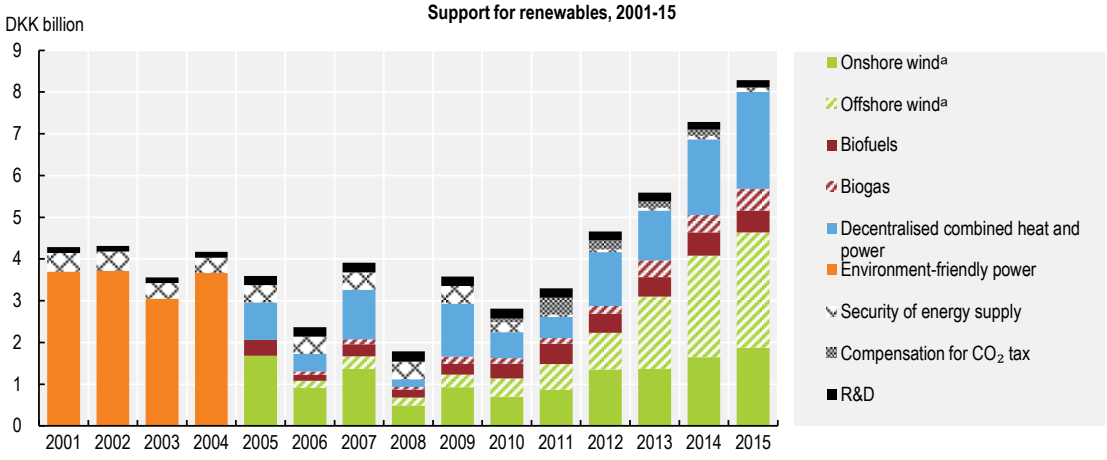
Current support policies were set up by the 2012 Energy Agreement and have since been adjusted several times. New post-2020 measures were agreed in the 2018 Energy Agreement. A "frozen policies" scenario modelled by the Danish Energy Agency shows

that without new measures such as those in the 2018 Energy Agreement and climate and air proposal, growth in renewables would stagnate and fossil fuel consumption rise after 2020, due in part to planned energy-intensive data centres,[11] so GHG emissions would begin increasing again from 2022 (EA, 2018[40]). If the 2018 Energy Agreement is fully implemented, GHG emissions will continue to decrease gradually after 2022 (Chapter 1).

Denmark's incentive structure had varying levels of success across renewable energy sources. Successful offshore wind tenders have resulted in record low prices, which, combined with technological advances, led to a 48% cost reduction in offshore wind between 2010 and 2016 (IEA, 2017[16]). The tenders have many successful characteristics, including guaranteed grid connection and electricity offtake and one primary entry point (one-stop shop) for permitting and licensing – both of which provide certainty to investors and drive costs down. Denmark has become a global leader in wind energy technology throughout the supply chain. Expansion of renewable and alternative fuels in the transport sector is increasing slowly. The support system for solar photovoltaic power has been revised several times over the last five years and the feed-in premium system was withdrawn for new projects in May 2016 because Energinet, the state-owned enterprise that runs the electricity and natural gas transmission systems, was receiving too many applications.

The overall cost of supporting renewables has increased quite sharply since 2010 (Figure 3.5), reaching over DKK 8 billion (EUR 1.1 billion) in 2015. The government estimates that subsidies totalled about DKK 8.5 billion in 2018, the largest share being for offshore wind. The increase was driven by steadily growing generation eligible for support (notably offshore wind) and low electricity prices. Some 62% of gross electricity is produced with renewables support (the average across 26 EU countries is 16%), though the unit support levels (direct cost per MWh of supported electricity) are lower than in some EU peers. The cost of support per unit of renewables generation is highest for solar and biogas (IEA, 2017[16]). Most existing support measures have been financed by the PSO levy, which is added to the electricity price. It is being phased out over 2017-21, after which renewables development will be supported directly from the state budget. The PSO, determined quarterly, rose along with growing subsidy expenditure, reaching DKK 7.3 billion in 2015. It covered nearly all subsidy expenditure that year.

Figure 3.5. The cost of supporting renewables has increased sharply since 2010



a) 2005: detailed breakdown not available.
Source: IEA (2017), *Energy Policies of IEA Countries: Denmark*.

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In 2017, the Energy Commission published recommendations on Danish energy policy after 2020. It estimated that the cost of reaching the target of 50% renewables by 2030 was manageable, provided Denmark could reduce the need for subsidies for renewables deployment and make development market-driven in the long term. The 2018 Energy Agreement aims to ensure a market-driven green transition. Among other things, it allocates DKK 4.2 billion (EUR 564 million) for technology-neutral procurement through tenders, and commits to harmonise and simplify subsidies as far as possible (Box 3.2). The agreement maintains sizeable subsidies to offshore wind and biogas. Both entail a risk of low value for money, but Denmark is willing to bear the high initial cost of being a front runner and exploring renewables options with environmental co-benefits (in the case of biogas).[12] The agreement also announced "continued extensive extraction" of North Sea oil and gas to generate funds for the state budget and investment for the green transition.

Box 3.2. Key components of the 2018 Energy Agreement

In June 2018, the Danish government and Parliament reached agreement on a new energy policy to 2030. The Energy Agreement aims to help Denmark source 55% of gross final energy consumption from renewables by 2030 and to phase out coal from electricity production by the same year. Key measures include:

- building three offshore wind farms with capacity of at least 2.4 GW
- allocating DKK 4.2 billion (EUR 564 million) to a tender process by which different technologies compete on delivering renewable electricity at the lowest price
- allocating DKK 4 billion (EUR 537 million) to expand green biogas production, including organic biogas
- allocating DKK 500 million (EUR 67 million) to green transport over 2020-24 to enhance green mobility and transport
- allocating DKK 500 million (EUR 67 million) annually to a market-based grant pool focused on energy savings (primarily in business) over 2021-24, of which DKK 200 million is earmarked for energy savings in buildings
- allocating DKK 100 million (EUR 13 million) annually over 2021-24 to help finance energy renovations in buildings owned or operated by municipalities or regions
- establishing a DKK 400 million (EUR 54 million) reserve in 2025 and allocating DKK 500 million (EUR 67 million) annually after 2026 to further enhance the use of renewables
- relaxing electricity and electric heating taxes by about DKK 2 billion (EUR 268 million) in 2025
- intensifying export promotion activities with DKK 174 million (EUR 23 million) over 2019-24
- increasing funding to energy and climate research to DKK 1 billion (EUR 134 million) by 2024.

Source: (Government of Denmark et al., 2018[41]).

Energy efficiency

Denmark's praiseworthy decoupling of GDP growth from energy consumption growth has been achieved through national energy efficiency objectives and various measures to meet them. A comprehensive energy savings strategy was published in 2014.

The main measure on the supply side is the Energy Efficiency Obligation (EEO) for grid and distribution companies in the electricity, natural gas, district heating and oil sectors. Initiated about 20 years ago, it is a market-oriented system in which participants can choose the most cost-effective measures to achieve savings. The system is financed by end-users via energy bills.[13] Annual saving targets set by the EEO have mostly been met. However, the additionality of the programme is rather low. There has also been concern about its rising cost to bill payers, in part linked to the lack of incentives for participants to reduce the cost of implementing the obligation (Fawcett, Rosenow and Bertoldi, 2018[42]; IEA, 2017[16]). The rising cost influenced recent reductions in EEO savings targets for 2015-20 (by about 15%). The 2018 Energy Agreement announced that the programme would expire in 2021, to be replaced by a market-based system, based on open tenders, in which bidders would offer energy savings at a given price. Savings are targeted in process energy in industrial and service businesses as well as the building sector. The new system is to be complemented by an information and data initiative to enhance knowledge about savings opportunities.

The Danish Energy Agency has used voluntary energy efficiency agreements with large, energy-intensive businesses since 1996. Businesses that enter into a binding three-year agreement and commit to improve energy efficiency obtain a substantial reduction of the PSO (though that tax will be phased out by 2021). As the International Energy Agency has recommended, an option for continuing such agreements would be to increase the electricity tax (or other energy taxes) in industry from the current DKK 0.004/kWh except for companies committing to efficiency agreements (IEA, 2017[16]).

Standards for new buildings have been strengthened considerably and are quite high. The rate of improvement of existing buildings is still quite low, despite numerous initiatives launched over the last several years, and is a major challenge for the future. One area that may require attention is energy labelling of buildings, which can have an impact on selling prices. The Energy Agreement commits to establishing a long-term building renovation strategy, including milestones for 2030, 2040 and 2050 (IEA, 2017[16]).

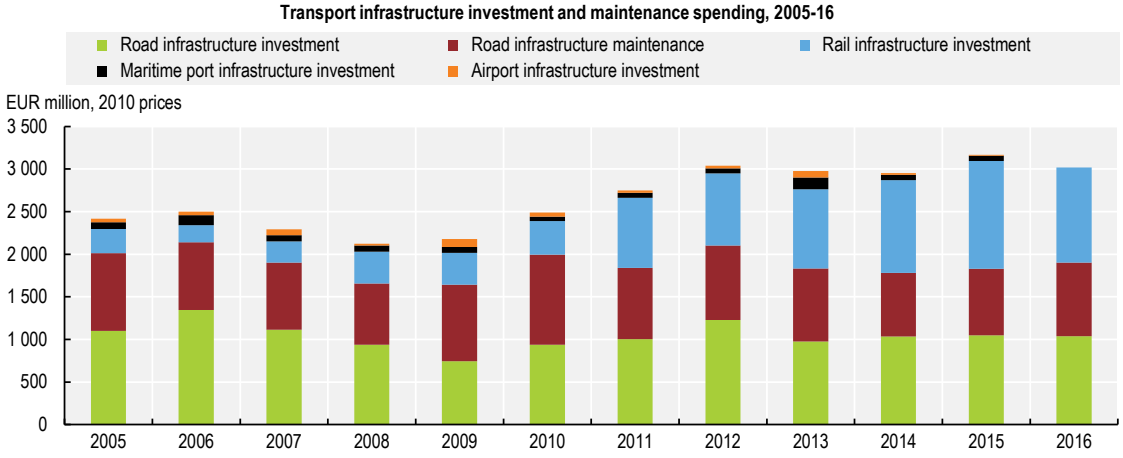
3.5.3. Investment in sustainable mobility

Government expenditure on transport increased by more than 50% over 2005-16 in real terms, driven by a notable increase in rail infrastructure investment (Figure 3.6). This increase reflects commitments made in the 2012 Transport Agreement to improve public transport, which includes development of a new metro line in Copenhagen and light rail in Aarhus and Odense, as well as investment to electrify and improve signalling on the railway network. A former government agreed on a DKK 28.5 billion (EUR 3.8 billion) investment plan to build new railways, upgrade existing lines and electrify the network. The conversion was supposed to be financed by the Train Fund (Togfonden). The project was put on hold shortly thereafter, however, and later limited in scope. Investment and maintenance expenditure on roads decreased over 2005-16, but remains higher than rail investment in absolute terms (Figure 3.6).

The 2018 climate and air proposal sets out goals and measures to reduce GHG emissions in the transport sector. These include stopping sales of new diesel and gasoline cars by

2030 and of hybrid cars by 2035; convening municipalities to discuss how to achieve zero GHG and air pollutant emissions from buses by 2030, building on Copenhagen's goal to use only electric buses by then; tightening taxi requirements so that no taxis emit GHGs or air pollutants by 2030; increasing scrapping premiums in an existing scrapping programme for old diesel vehicles;[14] investing in climate-friendly asphalt; and increasing the required biofuel content of gasoline and diesel to 8%. The proposal also announced surveillance of sulphur emissions from ships in Danish waters. For the longer term, towards 2030 and 2035, the government established a commission of experts and government officials to propose measures on the transition of car transport.

Figure 3.6. Investment in rail infrastructure increased



Note: Data for marine and airport infrastructure not available for 2016.
Source: ITF (2018), "Transport infrastructure investment and maintenance", *ITF Transport Statistics* (database).

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In March 2019, the government and the Danish People's Party agreed on a long-term infrastructure investment plan. It includes DKK 112 billion for 2021-30, of which 54% is dedicated to road and 46% to rail. Measures such as upgrading core sections of main highways, building new highways and corridors, and upgrading connections to central highway corridors are expected to reduce congestion. Investment is also planned to upgrade speed and capacity on the rail corridor from Jutland and Funen to Zealand. As the infrastructure investment plan includes projects that were found to have negative net present value (e.g. Routes 9, 11 and 15), Denmark should prioritise projects with high socio-economic returns and re-evaluate projects with potentially negative returns. The Danish Productivity Commission noted in 2014 that unprofitable transport investments had led to a loss of DKK 21 billion for society over the previous decade (Productivity Commission, 2014[43]).

Denmark had nearly 10 000 electric vehicles (EVs) on the road in 2017 (IEA, 2018[23]). This is rather low compared to European leaders such as Norway (about 170 000), the United Kingdom (140 000) and Germany (125 000), but Denmark's overall car fleet is relatively small. To promote EVs, Denmark began offering rebates on registration, sales and circulation taxes as well as local incentives such as waivers on tolls, parking fees and ferries. The decision to phase in a registration tax for EVs due to concern over the level of government revenue resulted in a significant decline of new EV sales from 2015. A freeze on the EV registration tax phase-in, adopted in April 2017, followed by an overall reduction

of the registration tax in October 2017, continued to provide mixed signals, undermining consumer confidence and limiting opportunities for a rebound. In late 2018, Parliament passed a bill exempting EVs and hybrids worth less than DKK 400 000 (EUR 54 000) from the registration tax in 2019 and 2020.

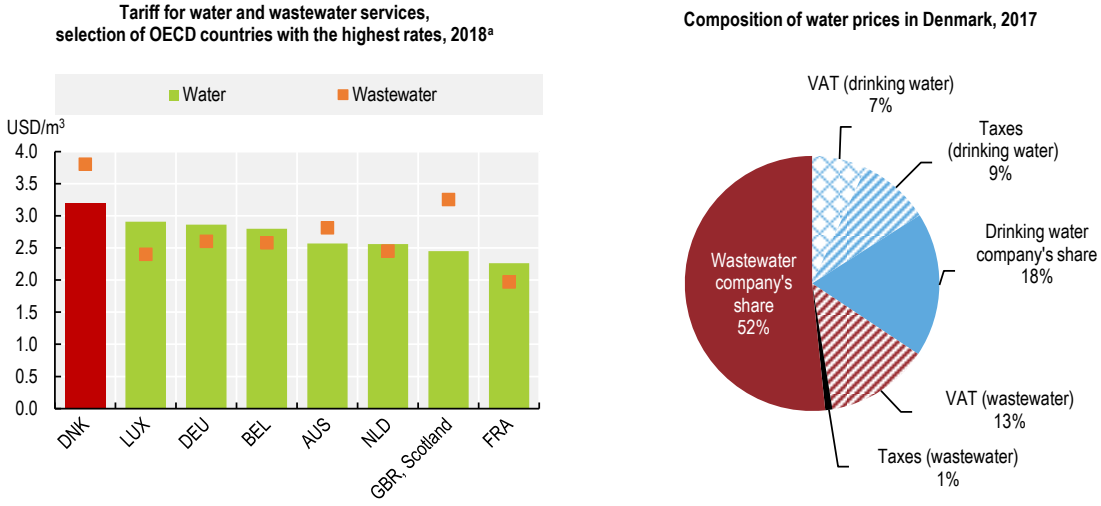
The Danish Road Directorate procured fast public EV charging points along the main highway corridors. EVs using such publicly accessible charging points get a 50% discount on the electricity tariff. Denmark is the only Nordic country that has used fiscal rebates on private charging infrastructure: homeowners who install an EV charging point can deduct the installation cost from their income tax. Until 2020, consumers who charge at home will receive a tax rebate of DKK 0.94/kWh (USD 0.14/kWh), cutting electricity costs almost in half. Denmark received the largest share of EU funding for charging infrastructure deployment in the Nordic region, participating in projects that totalled more than EUR 47 million and developed more than 150 public charging points (IEA, 2018[23]). It has a target of 3 000 publicly accessible charging stations by 2020, along with network coverage amounting to a charging point every 60 km. In this regard, the climate and air proposal announced investment of DKK 80 million (EUR 11 million) in new high-speed EV charging stations, along with regulatory changes (e.g. allowing municipalities to reduce parking charges for low-emission cars and let EVs drive in bus lanes). On the negative side, Denmark has some way to go to ensure interoperability of publicly accessible chargers. EV owners need different membership cards for access to outlets of the three main charging point operators. The government has discussed a policy framework to address this issue, but there have been no concrete implementation steps to date.

3.5.4. Investment in water and sanitation

There are 87 municipally owned water utilities and 100 municipally owned wastewater companies, as well as more than 2 000 private waterworks. Investment in and operation of public water supply and wastewater treatment are entirely financed by user charges. All water users (households and industry) are metered, and both public water supply and wastewater treatment are charged according to metered consumption. Average water prices paid by households are the highest among OECD countries (Figure 3.7), although prices and price structure vary across the country.[15] Price increases stimulated significant reductions in water consumption over the past decade, except in agriculture and industry (Chapter 1).

There are no social tariffs (water pricing is purely volumetric), but since its inception in 2009, the Danish Water Utility Regulatory Authority has set annual price caps on each company subject to regulation (i.e. municipally owned water supply and wastewater treatment companies). The Water Sector Act of 2009 sets requirements with respect to a price ceiling and efficiency of water companies' operating costs. The requirements are based on benchmarking[16] by the regulatory authority aimed at identifying efficiency potential in the sector and in individual companies (DANVA, 2016[44]). Ultimately, the regulation aims to imitate competitive pressure. The Water Sector Act was amended in 2016 to require utilities to meet efficiency targets for total costs (i.e. operating and investment). This has created some policy uncertainty that may have contributed to a drop in investment in 2016 and could affect planned investment levels in the near term (DANVA, 2017[45]). Parliament recently agreed to strengthen the regulation in coming years by introducing revenue caps that can be adjusted to actual investment, instead of being fixed at a historic level. This will help improve companies' ability to invest in new technology.

Figure 3.7. Water and wastewater tariffs are the highest in the OECD



a) Average tariff based on consumption of 15m^3 per month. Data include fixed and volumetric charges, exclude VAT and other taxes.
Source: International Benchmarking Network for Water and Sanitation Utilities (2019), *IBNET (*database); Danva (2018) *Danva Statistik & Benchmarking.*

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On the basis of the price caps, the company sets tariffs for the following year. The tariffs must be approved by the municipality. Regulation has been effective in stopping price increases observed since 2004; tariffs have remained relatively stable since 2009, and investments, especially in wastewater utilities, have increased since that year while operating expenses have fallen for both drinking and wastewater utilities. In the long run, the rate of reduction in operating expenses is expected to decrease, and as a consequence there will be more focus on reducing investment costs.

The price charged to users for drinking water (which is almost entirely from groundwater) covers the cost of groundwater protection, abstraction, treatment and delivery. The component charged for wastewater covers sewer operation, maintenance, renovation and expansion, as well as operation and inspection of wastewater treatment plants (DANVA, 2017[45]). The political decision in 2013 to gradually reduce the wastewater charges for large water users – up to DKK 700 million per year from 2018 has resulted in considerable discounts for large users such as slaughterhouses, refineries and breweries. The change from a flat charge to a regressive system (i.e. lower rates as consumption increases) aimed to reduce the share of total wastewater company costs that large consumers paid, which was considered disproportionate. The water companies compensate for this discount by either increasing efficiency or raising wastewater tariffs for other users (DANVA, 2017[45]). Properties discharging particularly polluted wastewater pay an additional fee on top of the annual fee for ordinary wastewater.[17]

3.6. Promoting eco-innovation and green markets

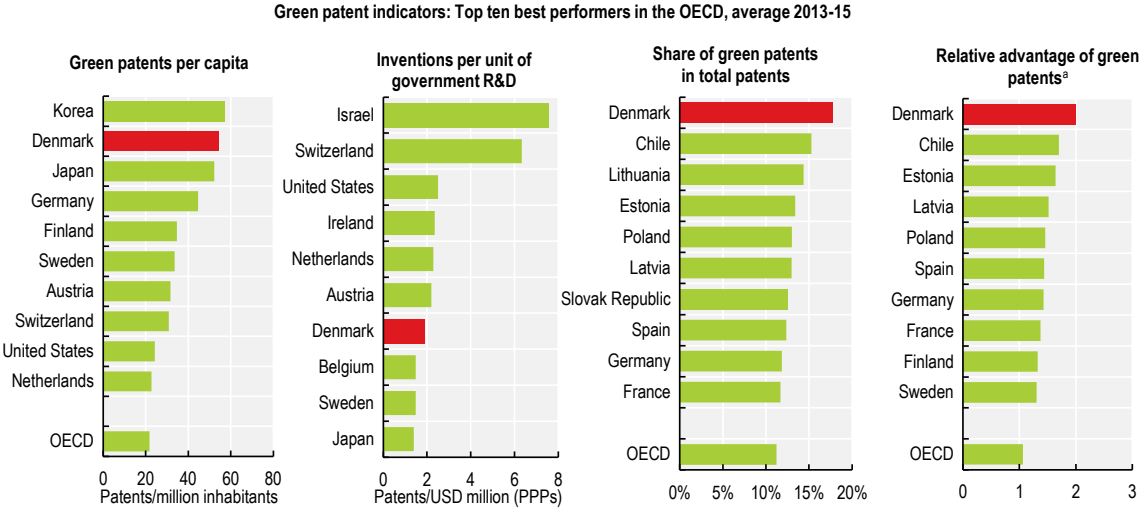
3.6.1. Eco-innovation

Denmark is an innovation leader: its innovation system ranked second only to Sweden among EU countries in 2017 (EC, 2018[46]). The business, entrepreneurship and innovation environment is one of the most favourable in the OECD, reflecting a flexible and well-functioning labour market, low regulatory barriers and high public spending on R&D.

In 2016, gross domestic R&D expenditure amounted to 2.9% of GDP, above the OECD average of 2.3%. Business R&D expenditure accounts for 1.9% of GDP, compared to 1.6% for the OECD. The high level of overall spending masks a strong concentration in a few large firms, dominated by pharmaceuticals and biotechnology. Only 25% of business R&D is attributable to small and medium-sized enterprises (SMEs) (OECD, 2019[1]).

Denmark has developed a high level of specialisation in environment-related technology (Figure 3.8). In 2015, 17% of high-value inventions were environment-related, down from nearly 25% in 2010 but still one of the highest shares among OECD countries. Per capita, Denmark ranks second among OECD countries, following Korea. Most patents are filed in the fields of wind energy and energy-related climate change mitigation technology.

Figure 3.8. Denmark is a leader in green innovation



Note: Patent statistics are taken from the Worldwide Patent Statistical Database (PATSTAT) of the European Patent Office (EPO), with algorithms developed by the OECD. Data refer to patent applications filed in the inventor's country of residence according to the priority date and apply solely to inventions of high potential commercial value for which protection has been sought in at least two jurisdictions.

a) Index of the specialisation in environmental innovation. It is calculated as the ratio of 1) the share of environment-related inventions on all inventions (in all technologies) at home and 2) the share of environment-related inventions on all inventions (in all technologies) in the world. The index is equal to 1 when the country's share of "green" technology is the same as the world's share; an index above 1 indicates a relative technological advantage, or specialisation, in environment-related technology compared to the world value.

Source: OECD (2018), "Patents", *OECD Environment Statistics* (database).

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Government budget allocations for environmental R&D reached 1.1% of the total government R&D budget in 2018; energy-related R&D reached 3% and agricultural R&D 2.7% (OECD, 2018[47]). While the energy-related R&D budget was halved over 2013-16 (Figure 3.9), Denmark committed to increase investment in clean energy innovation by doubling funding to the Danish Energy Technology Development and Demonstration Programme (EUDP) from DKK 292 million (EUR 39 million) in 2015/16 to DKK 580 million (EUR 78 million) in 2020 as part of Mission Innovation.[18] This will bring up total budget expenditure, although not to pre-2015 levels. The 2018 Energy Agreement announced gradually rising state funding for energy and climate-related research, development and demonstration (RD&D) to DKK 1 billion (EUR 134 million) in 2024.

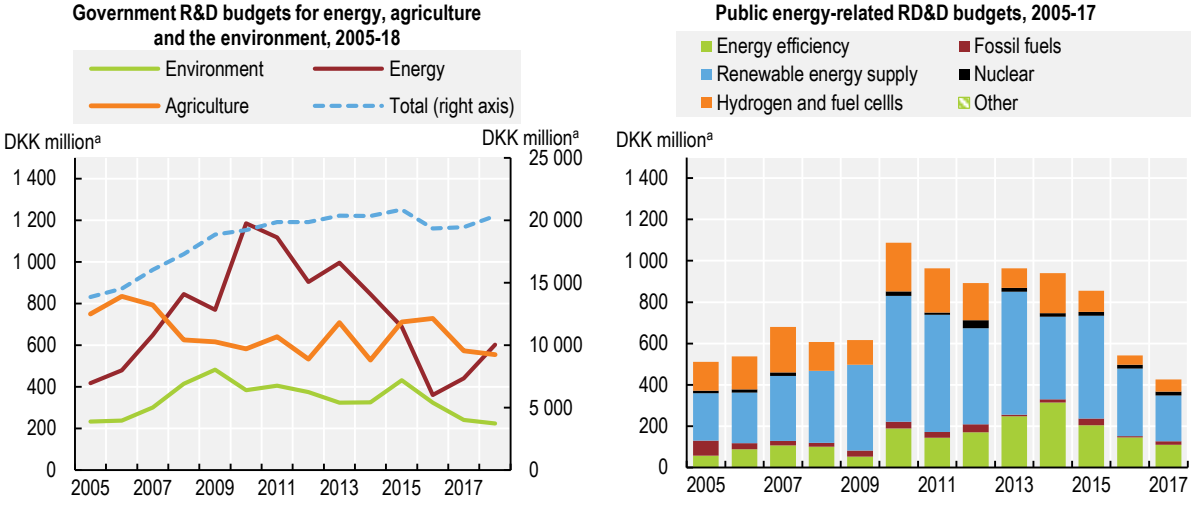
One of the most important RD&D programmes is the Danish Eco-Innovation Programme under MEF, which has supported development, testing and demonstration of environmentally efficient technology since 2007. Its budget in 2018 was about

DKK 86 million (EUR 12 million). An evaluation found that the fund led to significant business activity among participating companies: for every DKK 1 million in grants, participating companies had average annual turnover of DKK 2.9 million related to that technology, in addition to experiencing a stronger employment development than the Danish business sector in general (DAMVAD Analytics, 2017[48]). Most supported projects focused on reducing nitrogen load in water bodies and reducing CO_2 emissions. In addition, the Green Development and Demonstration Programme supports demonstration projects with positive environmental effects in the food industry. Its budget in 2018 was around DKK 206 million (EUR 27.6 million).

The greatest commitment to green technology and innovation has been in the energy area. Several RD&D programmes aim to increase employment, sales and exports, and reduce CO_2 emissions, in the energy sector. An evaluation of the three main programmes found that they were successful in meeting these objectives, in part due to their risk alleviation mechanism (COWI et al., 2015[49]). The largest programme is the EUDP, which provides grants for clean energy technology with commercial potential that could be exported to growing markets (EUDP, 2017[50]). Its 2018 budget was about DKK 400 million, down from more than DKK 1 billion in 2011. The 2018 Energy Agreement committed to increase funding for energy and climate-related RD&D to DKK 1 million by 2024.

The climate and air proposal allocates additional resources to climate-related R&D, including DKK 90 million (EUR 12 million) to develop low-GHG farming practices that have synergies with other environmental policies, and DKK 100 million (EUR 13 million) for carbon capture and storage in farmland and forests. Subsidies are provided to support conversion of peatland under agricultural development to permanent nature areas (Section 3.4.2). While agricultural R&D is high compared to agricultural value added, the additional resources for climate technology are welcome in light of the limited cost-effective solutions and lack of regulation for emission reductions for this sector to date, putting Denmark on track to establishing itself as a leader in providing climate-friendly agricultural products.

Figure 3.9. Energy-related R&D budgets have been falling



a) At 2017 prices.
Source: IEA (2018), *Energy Technology RD&D Budgets* (database); OECD (2019), "Research and Development Statistics: Government budget appropriations or outlays for RD", *OECD Science, Technology and R&D Statistics* (database).

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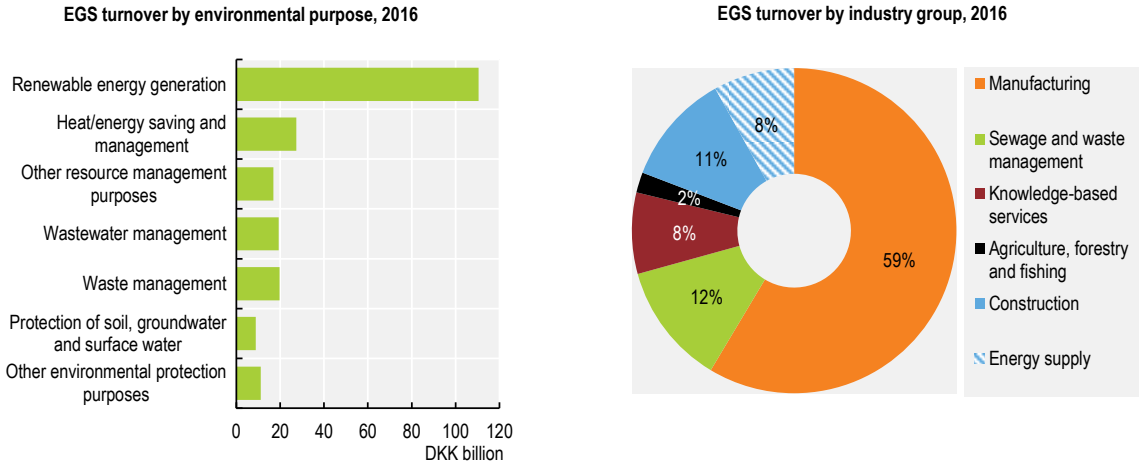
3.6.2. Environmental goods and services market

Environmental goods and services (EGS) contribute significantly to the Danish economy. Production in the EGS sector totalled DKK 214 billion (EUR 29 billion) in 2016, an increase of 23% in nominal terms from 2014 (Statistics Denmark, 2018[51]). The rise is linked extensively to the production and export of renewables technology, especially wind turbines. Despite stiff competition, the wind sector continues to perform well and drove turnover growth over 2012-16. Overall, 52% of EGS-related production in 2016 was related to renewables, followed by energy efficiency (Figure 3.10). The EGS sector employed 71 000 people, or 3% of the workforce (SD, 2018[6]), and accounted for nearly 15% of exports in 2015, the highest share among OECD countries (OECD, 2017[52]). Green technology continues to be a focal area for environment, climate and agriculture, and substantial subsidies for it are provided.

The number of Danish companies adopting the ISO 14001 environmental management system has fluctuated between 800 and 1 000 in recent years. It increased gradually from 2013, potentially encouraged by public support promoting uptake (Chapter 2). Many companies in Denmark use the European Eco Management and Audit Scheme, which sets stricter environmental targets and company performance standards than ISO 14001. In the agricultural sector, producers have been more resistant to environmental standards but use food-related eco-labelling (Varga, 2016[53]).

Demark has a well-functioning public procurement system that includes green, social, SME and innovation criteria. Green procurement criteria have been introduced for electricity-using products and the timber and transport product groups. National initiatives supporting uptake of green public procurement include knowledge-sharing networks, partnerships for front runners, best practice examples and a green public procurement task force to assist public authorities in implementing green public procurement (see also Chapter 4, Box 4.7). The Danish Environmental Protection Agency has published an e-learning tool to provide stakeholders with basic knowledge on green public procurement.

Figure 3.10. Renewable energy production accounts for nearly half of EGS turnover



Source: Statistics Denmark (2018), *Green National Accounts for Denmark 2015-2016.*

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3.7. Environment, trade and development

3.7.1. Trade and export credits

Denmark's open economy is highly dependent on foreign trade. Exports (in value added terms) contribute around 31% of GDP, below the OECD median but comparable with Sweden and Finland (OECD, 2017[54]). The transition towards a low-carbon, circular economy is seen as an economic opportunity through export of Danish environmental technology and services, notably in the energy technology field. Clean tech has been the fastest-growing Danish export sector in recent years. A major driver behind strong export performance is Denmark's international reputation as a front runner in green solutions, a strong framework of export financing, and assistance for internationalisation of innovation and commercial activities.

The export strategy for energy technology, presented in March 2017, envisages doubling exports of energy technology from around DKK 70 billion in 2015 to at least DKK 140 billion by 2030. The strategy sets a strategic framework for export initiatives in the energy sector and introduces new efforts, including a programme aimed at the United States, United Kingdom and Germany. It also contains instruments to advance green energy through the Danish International Development Agency (Danida) in high-growth and developing countries (Section 3.7.2).

Denmark backs the 2012 OECD Recommendation on Common Approaches for Officially Supported Export Credits and Environmental and Social Due Diligence. Its Export Credit Agency, EKF, maintains an active corporate social responsibility policy that complies with the OECD Guidelines for Multinational Enterprises as well as the UN Principles on Business and Human Rights and The Common Approaches. Denmark is also a signatory to the UN Global Compact and the Equator Principles. Accordingly, EKF incorporates evaluation of environmental and human rights risk in its risk assessment (OECD, 2016[55]). It discloses information on Category A projects (those with potential significant adverse environmental and/or social impact under OECD Common Approaches) at least 30 days before it is decided if EKF can take part. In 2017, EKF for the first time withdraw financing

from a copper mining project in Armenia, partly over non-compliance with terms of agreement on areas including tailing management and catch basin overflow (EKF, 2017[56]).

Between 2003 and 2013, Denmark provided more export credits for renewable power generation projects than any other OECD country, thanks to extensive support to wind energy. No support was granted to coal-fired power plants over the period, and the share targeting power generation projects based on oil, diesel or natural gas was relatively small (OECD, 2015[57]). EKF is a global leader in wind project funding, having financed more than 100 wind farms globally, worth more than DKK 100 billion, over the past 20 years. In 2017, wind projects made up 48% of EKF's total portfolio.

3.7.2. Development co-operation

Development co-operation and humanitarian action are guided by the World 2030 strategy, which is based on the 2030 Agenda and the SDGs. Inclusive, sustainable growth and development form one of the strategic aims, with a focus on energy, water, agriculture, food and other areas where Denmark has special knowledge, resources and interests (Danida, 2017[58]). The government aims to increasingly use official development assistance (ODA) to boost the contribution of the private sector to sustainable development in developing countries while promoting Danish technology transfer (MOF, 2017[2]). To this end, it aims to strengthen the Investment Fund for Developing Countries (IFU), Denmark's central development finance institution. The IFU manages two major blended finance[19] instruments: the Danish Climate Investment Fund and the Danish Agribusiness Fund (Box 3.3). While the focus on mobilising private sources for sustainable development is line with global efforts to scale up blended finance, it is important to ensure that these activities do not come at the expense of untied ODA.

Box 3.3. Using public-private partnerships in development co-operation

The **Danish Climate Investment Fund** was established in 2012 to promote climate-related investment in developing countries and emerging markets, combining commercial and environmental objectives with the goal of reducing global warming and contributing to climate change adaptation in developing countries while promoting transfer of Danish climate technology. The fund started in 2014 with capital of DKK 1.3 billion (EUR 174 million), of which 40% was public funding and 60% private (from Danish pension and capital funds). The fund is now fully invested. One of its biggest projects includes development of a 300 MW wind park in Kenya, the largest wind farm in Africa. The IFU expected annual return of 12%.

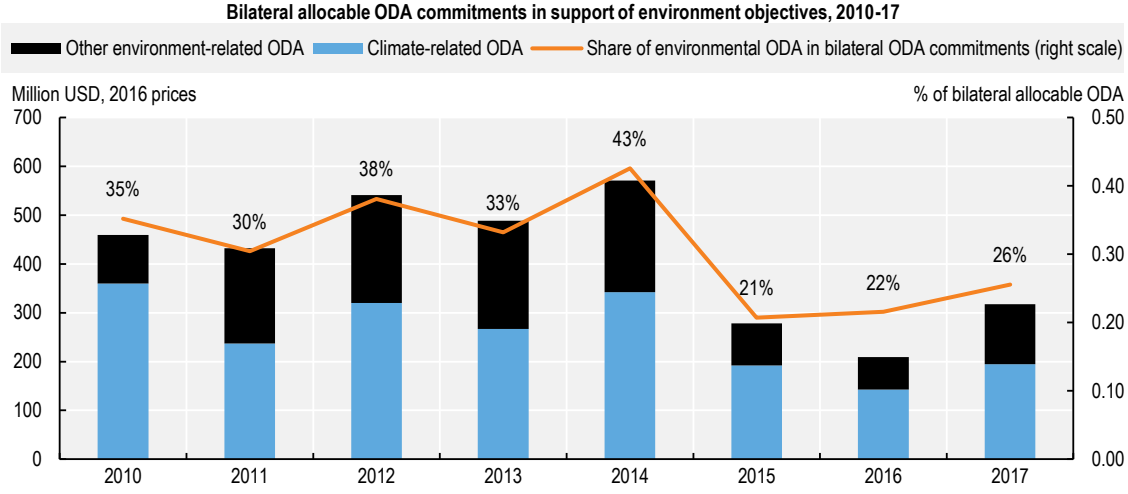
The **Danish Agribusiness Fund,** based on a similar model, was established in 2016 to provide risk capital for agriculture and food investment in developing and emerging countries and to promote sales of Danish technology and know-how. Of its total capital of DKK 800 million (EUR 107 million), 37% comes from public resources (the state and IFU) and 63% from Danish pension funds.

In June 2018, the prime minister launched the **SDG Fund** to enhance investment in key SDG areas by mobilising public and private capital, technology and know-how, and promoting responsible business conduct. It was established by six Danish pension funds and the IFU, which also acts as fund manager. By June 2018, capital commitments to the fund had reached DKK 4.1 billion (EUR 550 million), of which 60% was from private resources (each pension fund committed DKK 400 million) and 40% from public resources. It is expected that the fund will contribute to investment of at least DKK 30 billion. Investment will mainly be in sectors where Denmark has strong expertise and experience, such as renewables and energy efficiency, agribusiness and food, water and sanitation, and industry and services.

Source: (OECD, 2016[59]); IFU website (accessed on October 2018); country submission.

In 2017, Denmark provided USD 2.4 billion in net ODA, which represented 0.72% of gross national income (GNI) (OECD, 2018[60]). This makes Denmark one of five OECD Development Assistance Committee members to have met the UN target of allocating 0.7% of GNI as ODA. Net ODA disbursements have declined in recent years in real terms, reflecting the government's pre-election promise to bring the ODA/GNI ratio back to 0.7% from nearly 0.9% in 2014. This affected budget for support to sustainable natural resource management, the energy sector and climate change activities (OECD, 2016[61]). Taken together, environment- and climate change-related ODA dropped by 44% between 2014 and 2017 (Figure 3.11), creating a gap between strategic priorities and financial allocations. In 2017, 26% of Danish bilateral allocable development finance supported the environment, compares with the DAC country average of 33% in 2016 (OECD, 2018[62]). The overall decrease in ODA has, however, been accompanied by increased efforts to engage the private sector and mobilise private investment (Box 3.3).

Figure 3.11. Environment- and climate-related ODA has declined



Note: Data refer to activities that are marked with at least one of the environment and/or Rio policy markers. They include activities targeting the environment, climate change mitigation or adaptation, biodiversity conservation and sustainable use and/or desertification control either as explicit and fundamental objective of the activities or as important but secondary objective. The marker data do not allow exact quantification of amounts allocated or spent in support of the environment. They give an indication of such aid flows and describe the extent to which donors address these objectives in their aid programmes. Data do not necesseraly correspond with climate finance data reported to the UNFCCC.
Source: OECD (2019), *OECD International Development Statistics* (database); OECD calculations.

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The Danish Climate Envelope, established in 2008, is an important mechanism for channelling ODA to mitigation and adaptation activities. It also contributes to multilateral institutions, bilateral programmes in priority partner countries, framework agreements between Danida and Danish non-government organisations, and the IFU. In 2016, the government developed a document outlining guiding principles for using the Climate Envelope, as well as for monitoring and evaluating activities conducted through it (Danida, 2016[63]), as an internal evaluation recommended. The Climate Envelope's budget decreased after 2014, but increased to DKK 540 million in 2019 (Danida, 2018[64]).

Recommendations on moving towards green growth

Framework for sustainable development

- Continue developing green national accounts, publish them regularly and monitor their use in decision making; strengthen the statistical underpinning of the 2030 Agenda for Sustainable Development at the national level and ensure that indicators are as internationally comparable as possible.

Greening the tax system

- Reduce the energy taxation gap between households and businesses to equalise incentives for energy savings and CO_2 reduction; continue efforts to make electric solutions for heating and mobility more attractive vis-à-vis fossil-fuel-based options.
- Improve alignment of transport taxes with transport-generated externalities; in particular, ensure that lower taxes on vehicle ownership are matched by an increase in taxation of vehicle use (e.g. in congested areas).

Investment in a greener economy

- Continue to gradually phase out subsidies to renewables technology as it becomes economically competitive, and ensure that remaining support is technology-neutral.
- Regularly evaluate the effectiveness of and necessity for biogas subsidies; foster synergies between biogas development policies and nutrient management policies.
- Establish mechanisms to mobilise private investment in carbon capture and storage options, including those arising from peatland rewetting.

Eco-innovation and green markets

- Continue support for and ensure continuity of R&D in energy and other environmentally relevant areas, including climate mitigation options in agriculture and land use. Strengthen opportunities and incentives for more SMEs to engage in R&D.

Development co-operation

- Continue to use ODA to leverage private investment in projects supporting sustainable development, ensuring that it does not come at the expense of untied ODA.

Notes

[1] The tax on fossil waste applies only to heat produced from non-renewable industrial waste. Consumption of such waste is small.

[2] As the EU ETS covers electricity generation, a reduction in electricity use in Denmark has shifted CO_2 emissions to elsewhere in the EU. With the 2017 modifications of the EU ETS, lower electricity use in Denmark has some impact on EU-wide CO_2 emissions, but it is expected to be modest.

[3] The annual tax is levied on private cars registered since 1 July 1997 (cars registered before that date are subject to a weight-based tax) as well as on commercial vehicles registered since 18 March 2009.

[4] The registration tax provides discounts or extra charges depending on the car's fuel consumption. Requirements became more stringent in 2017. The current legislation allows a discount of DKK 4 000 for each kilometre a petrol-fuelled car travels in excess of 20 km per litre (22 for diesel cars), while the extra charge is DKK 6 000 per km/l a petrol car travels short of these values. As for the green owner tax, semi-annual rates vary from DKK 330 for petrol cars driving at least 50km/l to DKK 11 430 for cars driving less than 4.5 km/l (rates for diesel cars vary between DKK 130 to DKK 16 720).

[5] The Eurovignette is used in the Netherlands, Luxembourg, Denmark and Sweden. It was also used in Belgium and Germany before these two countries switched to distance-based pricing in 2016 and 2003, respectively.

[6] Preliminary estimate.

[7] The Ministry of Taxation has decided not to regard this measure as tax expenditure and thus stopped calculating revenue forgone. In CHP there is no physics law to determine the split between fuel used for heat and fuel used for power. The reduced energy duty for CHP generation is a way to determine the tax base for fuels used for heat production in CHP. The Ministry of Taxation does not consider this a subsidy for fossil fuels.

[8] The EU ecological focus areas cover a broad range of features, including ones that affect biodiversity directly (e.g. fallow land and buffer strips) or indirectly (e.g. reduced input use, better soil protection through catch crops or nitrogen-fixing crops).

[9] The transfer represented 5% of EU direct payments in 2015, 6% in 2016 and 7% from 2017 onwards, adding around DKK 460 million to the RDP programme in 2019.

[10] The statistics include only activities that directly serve an environmental protection purpose (such as waste or wastewater management) and exclude activities that produce specially designed products used to serve an environmental purpose (such as facilities for renewables).

[11] The authorities estimate that installation of six planned data centres will drive up Danish electricity consumption by between 13% and 15%.

[12] Digested manure provides high-quality natural fertiliser that emits less nitrous oxide than untreated manure.

[13] Oil companies include the cost of energy efficiency measures in their prices.

[14] The premium for scrapping diesel vehicles from before 2006 will be increased to DKK 5 000 (EUR 670); an additional DKK 100 million has been allocated for this purpose. The subsidy will be disbursed on a first-come, first-served basis.

[15] For example, some companies charge a fixed annual basic contribution for water and wastewater plus a variable price per cubic metre consumed, while others calculate and bill for water only according to the consumed amount.

[16] The efficiency requirement is based on a theoretical calculated net volume target. This enables comparison of multiple water companies, irrespective of size, type, framework conditions, number of customers, etc. The net volume target thus expresses how much in operating costs a company can be expected to have to match the average level of efficiency.

[17] This type of wastewater varies among properties and the fee is based on the pollution content of wastewater discharged by an individual company.

[18] Mission Innovation is a global initiative of 22 countries and the European Union to dramatically accelerate global clean energy innovation.

[19] The OECD defines blended finance as "strategic use of development finance for the mobilisation of additional finance towards sustainable development in developing countries", with "additional finance" referring primarily to commercial finance.

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Part II. Progress towards selected environmental objectives

Chapter 4. Waste, materials management and the circular economy

Denmark has long been an OECD leader in using incineration with energy recovery to reduce the amount of waste landfilled. Nevertheless, increasing household waste recycling and implementing meaningful waste prevention measures to address very high levels of waste generation are still major challenges. A new national strategy for circular economy, adopted in September 2018, and the subsequent political agreement aim to provide new impetus for alternative business models that put resource efficiency, waste prevention and recycling at the heart of production and consumption. This chapter gives an overview of trends in material use and waste generation, and of related policies. It reviews the effectiveness of instruments used to encourage waste prevention, reduction and recycling, and identifies implementation gaps and opportunities in moving towards a circular economy.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

4.1. Introduction

Denmark has long been a front runner in the OECD on reducing the amount of waste landfilled and viewing waste as an important resource. It has a comprehensive policy mix of regulatory measures (ban on landfilling waste that can be incinerated, compulsory audit of buildings to be demolished to facilitate removal of polychlorinated biphenyls [PCBs]), economic instruments (taxes on landfilling, waste incineration and packaging, product charges, raw material extraction tax, extended producer responsibility and deposit-refund programmes for beverage containers), market and innovation support measures (funding for innovation and green public procurement) and information programmes (eco-label promotion).

It has made impressive achievements in terms of recovery and recycling for most waste streams. In particular, construction and demolition (C&D) waste management is among best OECD practices. Household waste recycling, however, remains a notable exception. Heavy public investment in incineration for municipal waste treatment has created a path dependency featuring high levels of municipal waste generation and limited domestic recycling infrastructure. Municipalities, the main owners of waste incineration plants, face excess waste incineration capacity.

Current policies and strategies are trying to address these shortcomings, with mixed results. The 2016 Utilities for the Future strategy proposes an in-depth reorganisation of the waste management sector, increasing competition among incineration operators and the role of the private sector in collection and recycling. However, discussions over practical implementation have stalled, and uncertainty over the future waste management framework is deterring investment in a circular economy. In this context, the national circular economy strategy, adopted in September 2018, and subsequent political agreement provide a welcome new impetus for alternative business models that put resource efficiency and recycling at the heart of production and consumption.

This chapter gives an overview of trends in material use and in waste generation and treatment. It presents the Danish policy objectives and institutional settings for waste, materials management and transition to a circular economy. It also reviews the effectiveness of policy instruments used to encourage waste prevention, reduction and recycling as well as to manage the transition towards a circular economy.

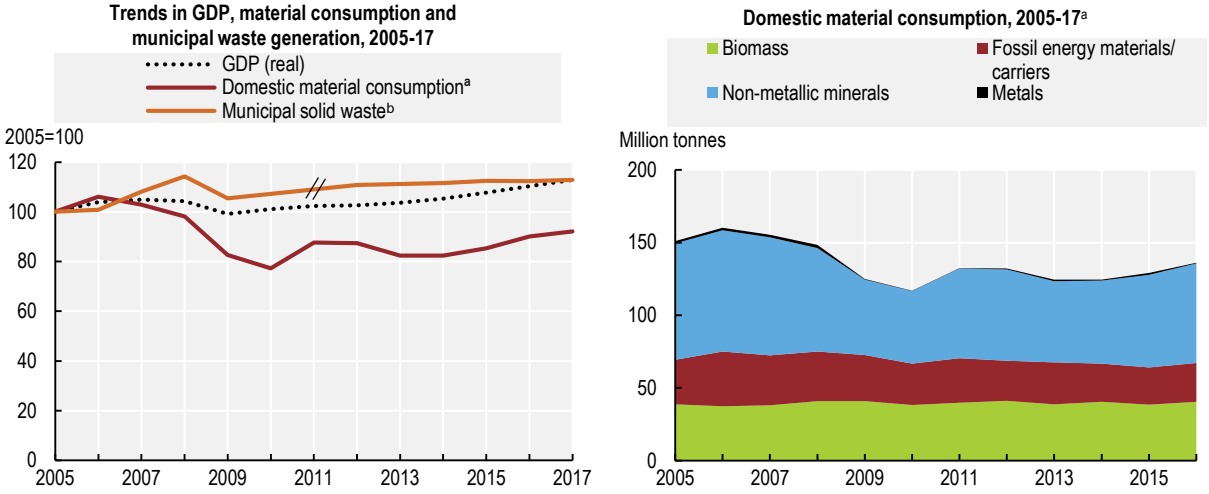
4.2. Trends in waste management and material consumption

4.2.1. Trends in material consumption

The Danish economy uses a significant amount of resources. In 2017, domestic material consumption (DMC) per capita was around 24 tonnes, far above the averages for OECD Europe (13 tonnes per capita) and the OECD (15 tonnes per capita). While DMC was decoupled from economic growth in 2008, at the time of the global economic crisis, it has been rising again since 2014 (Figure 4.1).

About half of DMC consists of non-metallic minerals, particularly stone, gravel and sand extracted from the environment for construction activities. Such activities thus heavily influence recent trends in material consumption. Since the economic slowdown ended, the construction sector has been recovering, boosted by large infrastructure projects such as the Copenhagen metro and Fehmarnbelt tunnel. Planned transport infrastructure investment is estimated at DKK 100 billion (EUR 13.5 billion). Over 2010-16, production grew by 17.2% in the construction sector and 36.6% in civil engineering (European Commission, 2018[1]).

Figure 4.1. Material consumption was decoupled from economic growth but is trending up



a) Refers to domestic material consumption, i.e. domestic material extraction plus imports minus exports of materials and derived products.
b) Break in time series in 2011.
Source: OECD (2019), "Material resources" and "Municipal waste generation and treatment", *OECD Environment Statistics* (database); OECD (2018), *OECD National Accounts Statistics* (database); Statistics Denmark (2019), "Economy-wide material flow accounts", *StatBank* (database).

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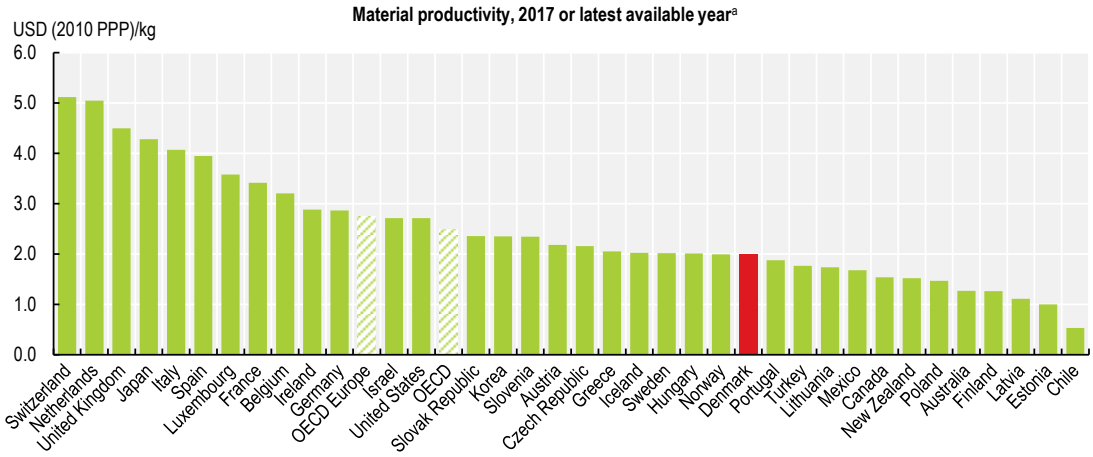
Denmark extracted around 110 million tonnes of raw materials in 2016 (58% of direct material input) and imported 65 million tonnes (37% of direct material input) of the resources needed for its economy. The main import category, representing half of total imports, is fossil fuels, even though Denmark extracted 11 million tonnes of oil and gas. It was a net exporter of crude oil for almost all the review period, but became a net importer in 2016 (SD, 2017[2]). Waste is also a noteworthy material flow, at 2.3 million tonnes exported and 1 million tonnes imported.

Resource productivity (economic value generated per unit of material used) increased from USD 1.57 to USD 1.99 per kg of material consumption between 2005 and 2017. This suggests that the economy generally used resources more efficiently towards the end of the review period. However, resource productivity remained below the averages for the OECD (at USD 2.49 per kg) and OECD Europe (USD 2.75 per kg) in 2017 (Figure 4.2). This reflects mainly the pre-eminence of the construction sector and high share of non-metallic minerals in DMC.

The Environmental Protection Agency (EPA) estimates that resource productivity will improve by 16% by 2030 (MEF, 2016[3]) but notes that past and future development in resource use and productivity heavily depends on the construction sector. Construction is unlikely to slow in coming years. Denmark has the third oldest building stock in Europe and energy policies may lead to increased refurbishment. Furthermore, climate change policies may require construction of coastal protection systems. Sand and gravel are abundant and cheap, and 87% of C&D waste is recovered, representing a limited alternative to the raw material.

Phasing out fossil fuels to meet the objective of reducing dependence on fossil energy carriers by 2050 will have limited impact on resource use. A reduction of fossil fuels in DMC from 24 million tonnes in 2014 to around 19.7 million tonnes in 2030 is expected.

Figure 4.2. Resource productivity remains low by international comparison



a) Material productivity designates the economic output (in terms of GDP) generated per unit of domestic material consumption (DMC), calculated as the sum of domestic extraction of raw materials used by an economy and the physical trade balance (imports minus exports of raw materials and manufactured products).
Source: Eurostat (2019), "Material flows and resource productivity", *Eurostat* (database); OECD (2018), "Material resources", *OECD Environment Statistics* (database).

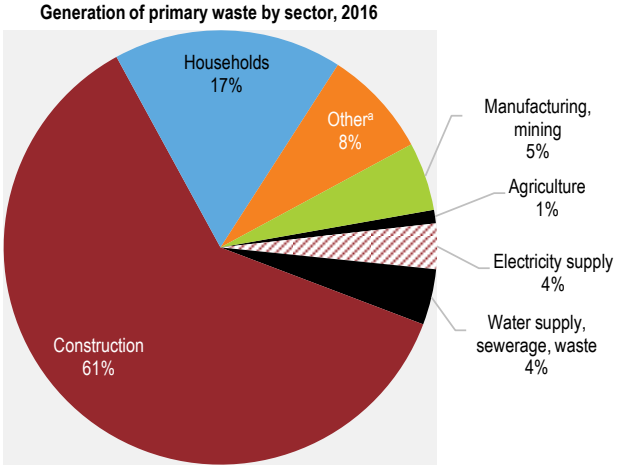
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4.2.2. Trends in waste generation and management

Total waste

Total waste generation increased substantially during the review period. Between 2010 and 2016, it rose by 30%, from about 15 million tonnes to 20 million tonnes. The increase was linked to C&D waste generation, which accounted for nearly 61% of total waste generated in 2016 (Figure 4.3). While waste generation increased overall, it decreased in several economic sectors, including utilities, mining and quarrying, and manufacturing.

Figure 4.3. Construction waste accounts for most of Denmark's waste generation



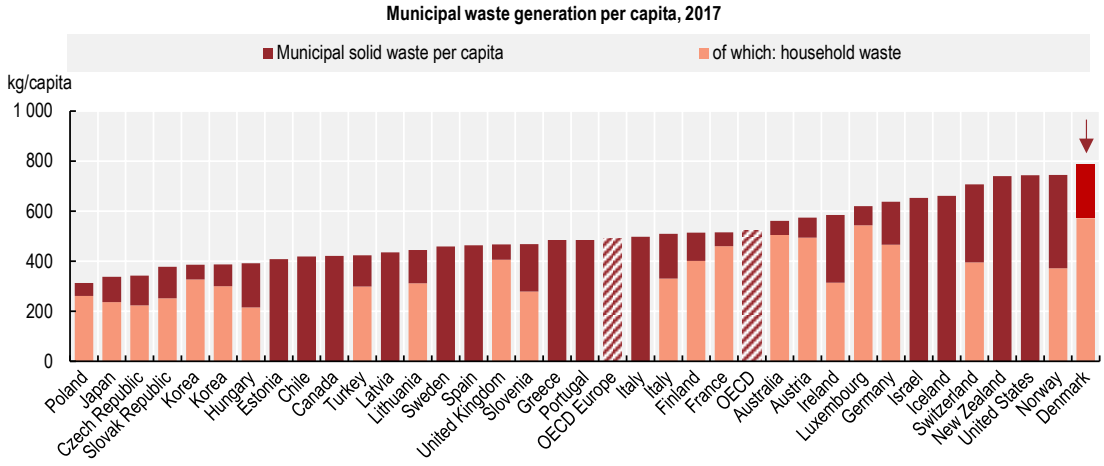
a) Includes waste generated by the service sector.
Source: Eurostat (2019), "Generation of waste by waste category, hazardousness and NACE Rev. 2 activity", *Eurostat* (database).

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Municipal waste

Denmark has reported the highest amount of municipal waste per capita in the OECD since 2007, reaching 785 kg per inhabitant in 2017, far above the OECD average of 524 kg (Figure 4.4). This may be due in part to national methodological specificities; for example, Denmark reported 127 kg of garden waste per capita under municipal waste in 2017. Even without garden waste, however, Denmark would rank among the six largest OECD municipal waste generators in 2017, at 658 kg per capita.

Figure 4.4. Danish per capita municipal waste generation is the highest in the OECD



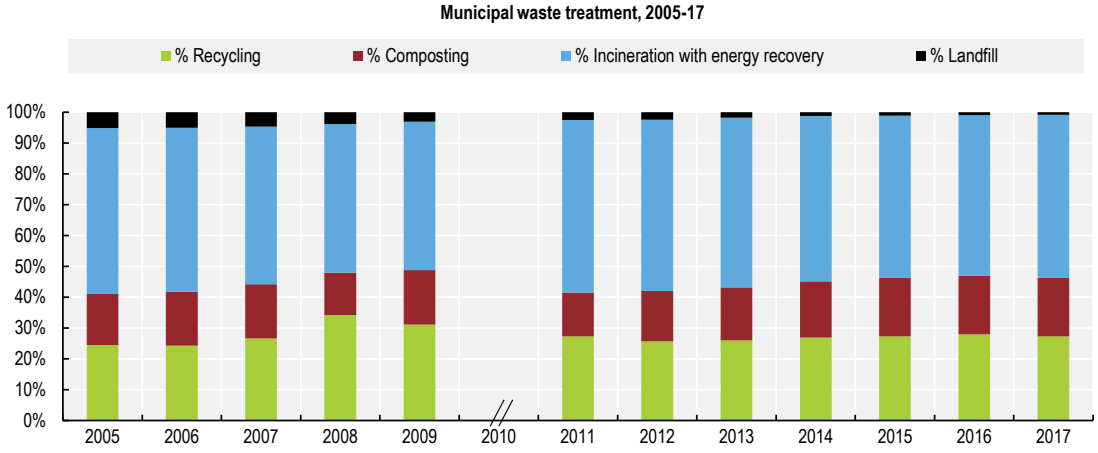
Source: OECD (2019), "Municipal waste", *OECD Environmental Statistics* (database).

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Overall, municipal waste generation has increased by 13% since 2005, though it remained stable at around 4.4 million tonnes per year after the introduction of a new waste information system in 2010. During the review period, in 2005-10 and 2011-15, municipal waste generation rose faster than private final consumption. A decoupling between municipal waste generation and private final consumption can be observed in 2016-17, the latest years for which data are available.

In terms of waste treatment, Denmark has been an OECD front-runner in diverting municipal waste from landfill, mainly through incineration with energy recovery. Landfilling decreased from 5% to 1% of municipal waste treated between 2005 and 2017. Incineration with energy recovery accounted for 53% of municipal waste treated in 2017. The rest was composted (19%) or recycled (27%) (Figure 4.5).

Figure 4.5. Denmark has nearly eliminated landfilling of municipal waste



Note: 2010 data are not available, break in time series in 2011; recycling rates maybe underestimated due to lack of reporting.
Source: OECD (2019), "Municipal waste generation and treatment", *OECD Environment Statistics* (database).

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Hazardous waste

Hazardous waste represents a small fraction of total waste generation in weight (9% in 2016), but adequate management is crucial to minimise risk to human health and the environment. Since 2011 and the launch of the new waste information system, the level of hazardous waste generation has varied: 422 000 tonnes in 2013, 584 000 tonnes in 2015, and back down to 550 000 tonnes in 2016. The fluctuation mainly reflects an increased focus on collecting and treating waste contaminated with PCBs, in particular when demolishing old buildings containing PCBs. In 2016, 42% of hazardous waste was recycled, 23% incinerated and 17% underwent special treatment, with only 18% destined for disposal.

Specific waste streams

For several waste streams, Denmark experienced significant variations in waste generation during the review period, mainly following economic trends. Waste generation is now back on the rise. For all waste streams, Denmark has made remarkable achievements in terms of recycling and recovery.

Regarding C&D waste, generation declined during the economic crisis and has been rising again since 2011, with 4.3 million tonnes generated in 2016. Denmark achieves high recovery levels for such waste: around 95% over 2007-09 and slightly lower in later years (down to 87% in 2016), probably due to methodological changes as well as improved removal of PCB-contaminated waste.

Packaging waste generation also decreased substantially during the financial crisis, from around 900 000 tonnes in 2008 to 690 000 tonnes in 2009 and 2010, but has since been rising, with 880 000 tonnes generated in 2016. Reported recovery and recycling rates in this stream are also remarkable: in 2015, Denmark recovered 94% of packaging waste and recycled 74%.

During the review period, collection of end-of-life vehicles (ELVs) was stable at around 100 000 tonnes, increasing substantially in 2012 (114 000 tonnes) and 2013 (129 000 tonnes). Due to the financial crisis, car owners may have postponed replacing old

vehicles, resulting in a scrappage peak thereafter. In 2016, recovery and reuse was estimated at 95% while recycling and reuse reached 89%.

The amount of waste electrical and electronic equipment (WEEE) peaked in 2007 at 98 000 tonnes. It amounted to around 72 000 tonnes in 2015. Recycling and recovery levels that year were high at 84.2% and 92%, respectively.

Industrial waste steadily declined over the period, from 1.8 million tonnes in 2005 to 1.1 million tonnes in 2016. In terms of treatment, 73% of industrial waste is recycled, 18% incinerated and 9% destined for disposal.

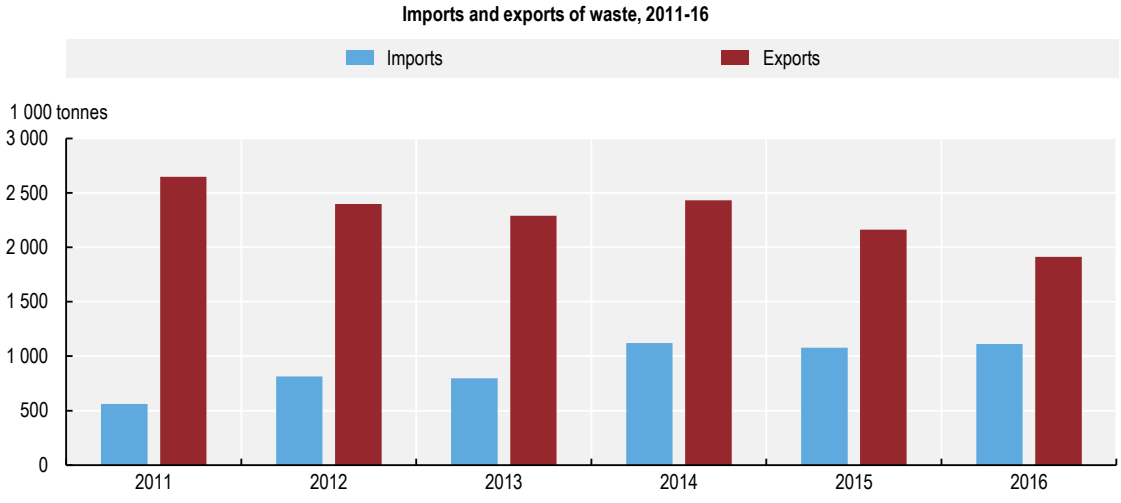
Waste shipment

Regarding transboundary movement of waste, Denmark mainly trades waste for recovery with neighbouring European countries and Turkey. Waste destined for recovery represented 93% of imports and 97% of exports in 2015.

Iron, paper and cardboard are among the main export categories, reflecting the limited domestic recycling capacity for these waste streams. Denmark has no steelworks using scrap, and a few and relatively small paper and cardboard mills. The main destination countries for exports are Germany, Turkey, Norway and Sweden. Waste exported to Turkey consists mainly of waste metal.

Imports of waste have risen significantly since 2011, mainly due to increasing import of waste suitable for incineration, but have stabilised since 2014, reflecting excess incineration capacity (Figure 4.6).

Figure 4.6. Imports of waste rose significantly from 2011 but stabilised in 2014, while exports are trending down



Source: EPA (2018), *Affaldsstatistikken 2016*, [Waste Statistics 2016] (and previous issues).

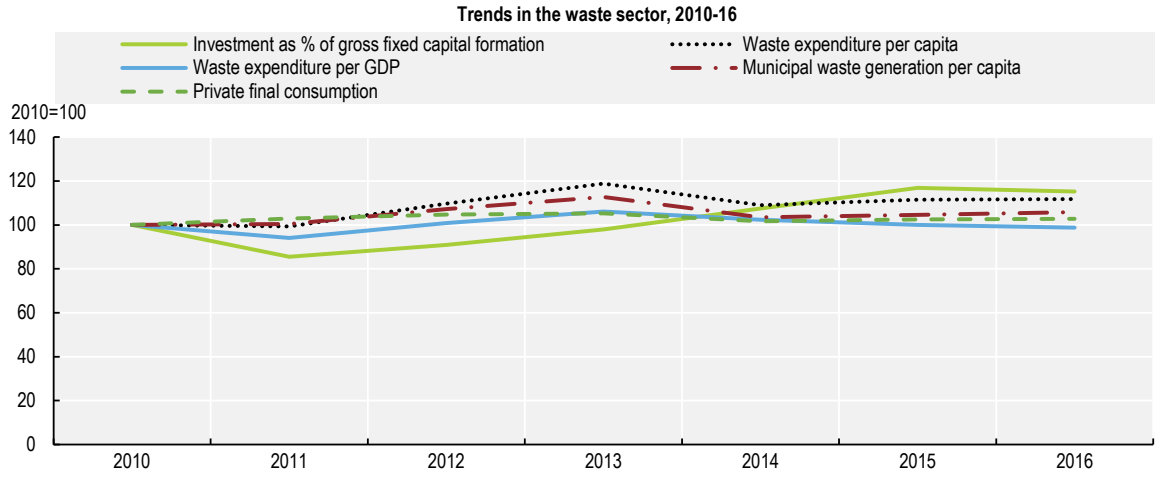
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Waste management expenditure

Overall, the cost of waste management services increased substantially during the review period. Total public expenditure (current and capital expenditure) on waste management increased by 17% between 2005 and 2016 to around DKK 11.5 billion (EUR 1.54 billion).

Investment in waste management has increased by 15% since 2010 (Figure 4.7). In 2016, total turnover of public and private companies in waste management amounted to DKK 17.2 billion (EUR 2.3 billion) in 2016.

Figure 4.7. Expenditure and investment trends in municipal waste management

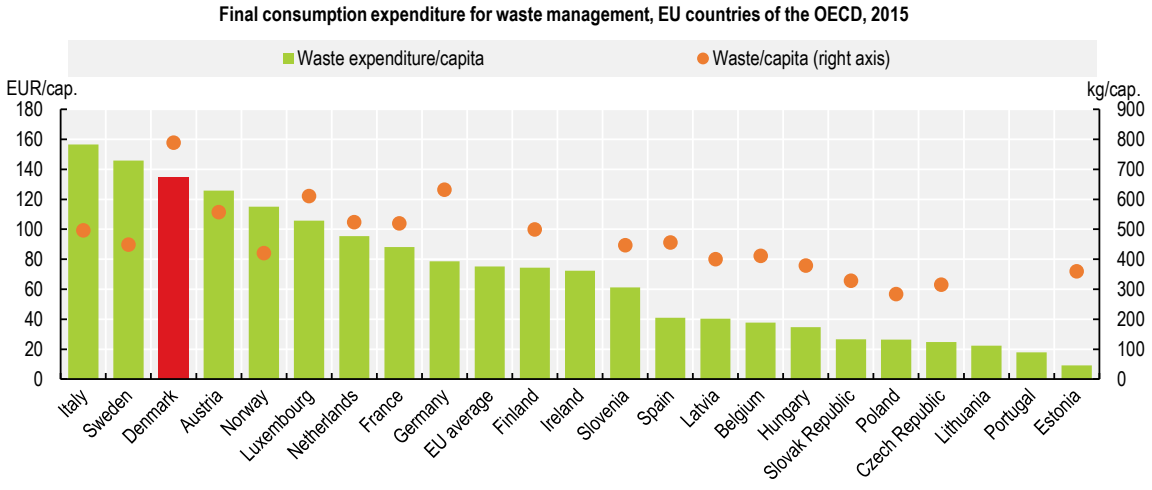


Note: Data refer to expenditure for waste management from the public sector.
Source: Statistics Denmark (2018), "Environmental and economic accounts", *StatBank* (database); OECD (2018), "Municipal waste generation and treatment", *OECD Environment Statistics* (database).

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The cost of waste management services for Danish households is among the highest for EU countries of the OECD. The cost has grown faster than municipal waste generation (Figure 4.8). Thus the increase reflects not only higher levels of waste generation but also a rise in average cost per tonne.

Figure 4.8. The cost of waste management for Danish households is high by international comparison

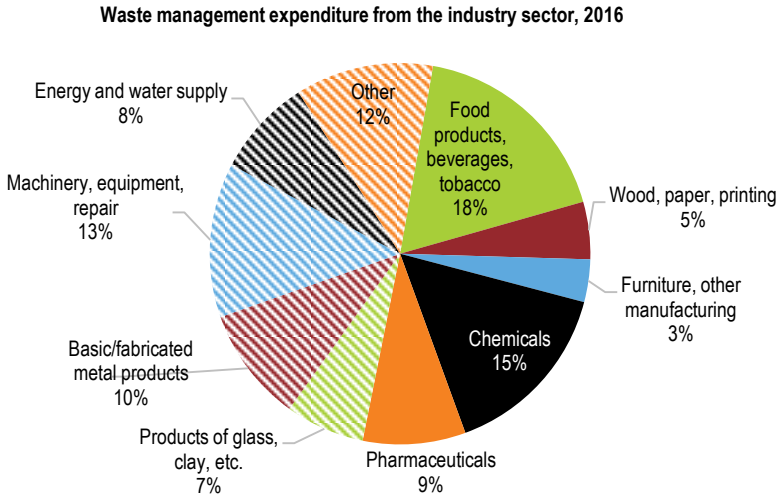


a) Includes waste generated by the household and service sectors.
Source: Eurostat (2018), "National expenditure on environmental protection by economic characteristics", *Environmental Protection Expenditure* (database); OECD (2018), "Municipal waste generation and treatment", *OECD Environment Statistics* (database).

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Although the amount of industrial waste is decreasing, waste management expenditure by Danish manufacturing industries is on the rise and reached about DKK 800 million (EUR 107 million) in 2016. The food and beverage industry and the chemical sector have the highest expenditure levels (Figure 4.9).

Figure 4.9. Waste management expenditure by industry



Note: Data refer to expenditure for waste management from the manufacturing industry.
Source: Statistics Denmark (2018), "Environmental and economic accounts", *StatBank* (database).

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4.3. Objectives, policies and institutions for waste, materials management and circular economy

4.3.1. Policy framework and objectives

During the review period (2005-18), Denmark defined its main policies and objectives related to waste management in a series of plans and strategies.

The third national Danish Waste Plan, launched in 2003 for 2005-08, aimed not only at reducing the environmental impact of waste but also increasing effectiveness in the waste sector. In terms of waste prevention, the objective was not to decrease overall waste generation but rather to decouple its increase from economic growth. The plan included targets to increase recycling to 65% and incineration with energy recovery to 26% while reducing landfilling to 9%. It also included EU requirements and targets for certain waste streams (packaging, WEEE, ELV) (Copenhagen Resource Institute, 2013[4]).

The fourth national Danish Waste Plan (2009-12) was developed in two parts: a strategic part linking waste management with the objectives of climate, resource and environmental protection policy, followed in 2010 by a second part focusing on prevention, particularly as regards food waste. The main targets from the previous plan were unchanged except the one on landfilling, which was lowered to 6% by 2012.

The current strategy on waste management and resources, launched in 2013 as Denmark without Waste: Recycle More, Incinerate Less (Government of Denmark, 2013[5]), represents a paradigm change for a country that relies heavily on incineration with energy

recovery to divert waste, especially household waste, from landfill. The strategic goals are reflected in the latest national waste management plan, Denmark without waste: Resource Plan for Waste Management 2013-2018, launched in 2014.

The strategy and plan establish one main quantitative target: to collect 50% of seven household waste fractions (biowaste, paper, cardboard, glass, wood, plastic and metal) for recycling by 2022 (by contrast, 75% of household waste was incinerated in 2011). This target reflects the EU Waste Framework Directive target of separately collecting 50% of the dry fractions of municipal waste (paper, cardboard, plastic and metal), although the EU targets have a different basis for assessment. In addition, the strategy includes indicative targets to measure its effects on specific sectors (Table 4.1). For instance, recycling of organic waste from the service sector (restaurants, food shops) is expected to reach 60% by 2022. Apart from the household waste target, most legally binding targets for waste management derive from EU targets.

Table 4.1. Denmark has a mix of mandatory and indicative targets for waste and resource management

Mandatory targets for municipal waste management are mainly derived from EU directives

Waste	Targets			
	2020 %	2025 %	2030 %	2035 %
Household waste (collected for recycling)	50			
Municipal waste (actual recycling)	-	55	60	65
Landfill	-			10
Packaging waste	55	65	70	
Plastic	22.5	50	55	
Wood	15	25	30	
Iron and metal	50 (all metal)	70	80	
Aluminium		50	60	
Glass	60	70	75	
Paper and cardboard	60	75	85	

Source: Country submission.

Indicative targets (expected effects) are set in the 2013 "Denmark without Waste" strategy

		Expected effects		Baseline (2011 figures)		
		2018	2022 goal	Recycled	Incinerated	Landfilled
Source	Material type (fraction)	Min%	Min%	%	%	%
Households	Collection of WEEE	75		68*		
Service sector	Recycling of paper, cardboard, glass, metal and plastic packaging	70		53	47	0
	Recycling of organic waste	60		17	83	
All	Energy recovery from garden waste	25		87	4	4
	Collection of WEEE	65				
	Collection of batteries	55		47		
	Recovery of shredder waste	70		0		
	Recycling of phosphorus in sewage sludge	80				

* Average of amount placed on the market in the past three years.
Source: Country submission.

A waste prevention strategy, Denmark without Waste II (Government of Denmark, 2015[6]), was launched in 2015 for 2015-27. It identifies two crosscutting topics (supporting resource efficiency among businesses and green consumption) and five action areas (food waste, construction, textile, electrical and electronic equipment, and packaging). The strategy has seven qualitative targets combined with nine quantitative indicators to monitor progress on all topics and action areas, such as the number of businesses with a certified environmental management system, the number of eco-labelled products, and waste generation in specific industry sectors and in households. A six-year revision of the strategy is envisaged.

A circular economy strategy (MEF and MIBFA, 2018[7]) was adopted in September 2018 (Box 4.1). It does not include additional policy targets, but instead recognises the role of private companies as a driving force for the transition to a circular economy, envisaging voluntary commitment by the private sector to increase resource productivity by 40% between 2014 and 2030 and increase recycling to 80% of total waste (excluding mineral waste) generated.

Box 4.1. The advisory board on circular economy and the circular economy strategy

Denmark has long been involved in preparation of its circular economy strategy. In the autumn of 2016, the government established the **advisory board on circular economy** composed of 12 business leaders representing companies of all sizes and from a range of sectors. The board was chaired by the chairman of Carlsberg, and benefitted from a joint secretariat formed by MEF and MIBFA. The EPA and the Danish Business Authority were also part of the secretariat.

The board published its main report with 27 recommendations in June 2017 (MEF, 2017[8]). It recommended that Denmark should adopt the following objectives:

- deriving more value from materials to increase resource productivity by 40% (based on amounts) and 15% (based on value)
- increasing circularity to 80% recycling of total waste (excluding mineral waste) and reducing total waste (excluding mineral waste) by 15%
- retaining the lead in development of circular technology and solutions
- using excess capacity better by getting 50% of the population active in the sharing economy
- boosting circular economy by quadrupling turnover of eco-labelled products and services.

Denmark launched the **circular economy strategy** in September 2018. It identifies 15 initiatives in six main chapters:

- strengthening companies as the driving force for the circular transition
- supporting circular economy through data and digitalisation
- promoting circular design
- changing consumption patterns through circular economics
- creating a well-functioning market for waste and secondary raw materials

- deriving more value from buildings and biomass.

The recommendations from the advisory board and the strategy are supported by key business organisations, including the Confederation of Industries, the Chamber of Commerce, the Construction Association and the Agriculture and Food Council.

The strategy also refers to the new mandatory EU targets and requirements. In May 2018, the EU adopted a circular economy package introducing ambitious binding targets for recycling of municipal waste (55% in 2025, 60% in 2030 and 65% in 2035) and packaging waste (65% in 2025 and 70% in 2030). Other new requirements relevant for Denmark include separate collection of biowaste by 2023 and establishment of extended producer responsibility for packaging by 2025.

Other national strategies are of relevance for Denmark's waste, materials management and transition to a circular economy. The national strategy on the sharing economy (Government of Denmark, 2017[9]) aims to maximise use of assets such as cars and buildings, ultimately leading to less consumption. A utilities strategy, Supply for the Future, which is under discussion, is expected to significantly modify the organisation of waste management services. It proposes increased competition in the incineration sector by letting business freely choose where to send combustible waste and making it compulsory for municipalities to organise public tenders for household waste treatment for recycling and incineration. It also suggests directing all recyclable waste treatment to the private sector; the role is currently divided between municipalities and the private sector.

4.3.2. Legal framework

Denmark has an extensive legal framework to address the environmentally sound waste management. It consists of a general framework law complemented by regulations for specific waste streams, treatment methods and specific policy aspects of waste management (data system, deposit programmes).

The Environmental Protection Act (Consolidation Act No. 966 of 23 June 2017) provides the general framework law and establishes the main objectives of environmental protection, including for waste. It is accompanied by a framework regulation, the Statutory Order on Waste (Affaldsbekendtgørelsen), the main legal instrument governing waste management.

Regulations cover various waste streams (batteries, ELVs, tyres, WEEE, residual waste, bio-ash, soil moving), waste treatment types (incineration, landfill) and aspects of waste management policies (data, register, impact assessment, environmental supervision, deposit systems). Regarding taxation, a 2011 law establishes taxes on waste and raw materials while a regulation establishes a packaging tax.

4.3.3. Institutional framework and governance

At the national level, responsibility for waste management policy is shared by the Ministry of Environment and Food (MEF) for overall policy objectives (environmental aspects, recycling promotion, etc.) and the Ministry of Climate, Energy and Utilities (MCEU) for economic regulation of the sector and delivery of waste management services.

The transition to a circular economy is the primary responsibility of MEF, which co-ordinates inter-ministerial processes involving other ministries (Ministry of Industry, Business and Financial Affairs (MIBFA), MCEU, Ministry of Transport and Building, and Ministry of Higher Education and Science). This includes co-ordination of the circular

economy strategy. MEF also co-ordinated an inter-ministerial task force on increased resource efficiency, which carried out studies to identify barriers to business uptake of resource efficiency policies. Activities are being conducted to create communication tools and guidance on the definition of waste and end-of-waste criteria, waste import and export rules, and interpretation of VAT regulations for used products.

Denmark has a strong tradition of stakeholder platforms and reflection groups, with many councils, advisory boards and partnerships involving public authorities. The Bioeconomy Council gathers businesses, industry associations and universities to promote development of value chains and is working on bio-based products, focusing on plastics, textiles and construction. The advisory board on circular economy (Box 4.1) prepared recommendations on elaboration of the circular economy strategy. Partnerships involving industry and business as well as public authorities deal with a wide range of practical issues related to implementation of national strategies on green public procurement, WEEE collection, sustainable construction and waste prevention, reduction of food waste, etc.

At the local level, the 98 municipalities are the main entities responsible for waste management. The five regional councils were in charge of orphan contaminated sites, but in March 2019 the government decided that this and other regional responsibilities would be transferred to the national level. Municipalities benefit from a large degree of autonomy in waste management planning and develop 12-year waste management plans at least every 6 years, in addition to infrastructure development, permitting and monitoring of waste management facilities (except the largest ones, which are controlled at the national level). Inter-municipal co-operation is also common. In many cases, municipalities own or co-own waste treatment facilities. Eighty-two municipalities are owners or co-owners of waste incineration plants.

Municipal responsibilities are evolving. Since January 2010, they are no longer responsible for managing recyclable waste from businesses, including commercial, industrial and C&D waste. Thus they can no longer collect or treat this waste, with some exceptions, for instance where waste is collected from buildings with both households and businesses. In addition, 23 municipal waste facilities hold permits to continue treating waste from businesses.

As municipalities are in charge of waste classification, they are largely free to direct high shares of total waste to the treatment facilities of their choice (e.g. the incinerator they own). What one municipality considers waste may not be classified as such in a neighbouring municipality. Waste classified as recyclable in one municipality is suitable for incineration in another. There have been complaints by private companies and industry sectors about waste classification differing among municipalities, adding to operators' administrative burden. This lack of harmonisation makes the playing field uneven for enterprises operating across municipal borders.

In addition, as the majority of municipalities own or co-own incineration plants and have excess treatment capacity, they tend to direct waste to the incinerator they own. There are no market-based incentives for municipal incinerators to compete on price, environmental performance and efficiency; tipping fees range from about EUR 34 to about EUR 120 per tonne of waste incinerated.

The circular economy strategy and political agreement aim at harmonising criteria for waste sorting and collection to create economies of scale. The Utilities for the Future strategy is also expected to increase competition and tendering in the waste incineration sector, which would improve cost-effectiveness. There is some evidence that flow control between

municipalities, resulting in restricted competition in the incineration market, leads to higher treatment costs. A Norwegian study found that the average price charged for treatment of combustible waste where there was competition was less than half that charged for similar waste subject to a monopoly obligation (OECD, 2013[10]).

4.3.4. The information base

Denmark is well equipped to monitor trends in waste and materials management, with a comprehensive system on material flows and management in its green national accounts under Statistics Denmark. The green national accounts follow international guidelines such as the Central Framework of the UN System of Environmental-Economic Accounting. They capture flows of natural resources, materials and waste as well as information on natural resource stocks and green economy indicators.

Regarding material flows, the green national accounts take an economy-wide approach, with indicators such as DMC, direct material input, imports, exports and resource productivity calculations. Denmark also uses environmentally extended input-output analysis, with input-output tables in monetary units for the various sectors of the economy, and is a front runner in developing this type of data. Statistics Denmark has been working on detailed supply and use tables and input-output tables for 20 years. Annual monetary supply and use tables feature a breakdown of 117 industries and some 2 300 products.

More recently, Statistics Denmark developed material flow accounts broken down by industry and households, thanks to extra government funding for 2015-17. This level of detailed data is still in prototype and not fully quality assured or consistent. It is likely to enrich a well-developed information base and help in monitoring progress in the transition towards a circular economy, as well as SDG reporting. Extra funding has also been secured for 2019-20 in conjunction with a project to better incorporate green national accounts into economic models.

In 2016, the EPA published a report on material resource productivity with a detailed analysis of recent trends and scenarios for development of resource productivity. A pilot project is under way to develop a raw material consumption indicator measuring all material resources used in the economy, including resource use embedded in imports.

The waste information system, an EPA responsibility, improved considerably in 2010 with the launch of a waste data system, AffaldsDataSystemet (ADS), and is now based on a waste management register with mandatory reporting from waste collectors, receivers, exporters and importers. Previously only waste treatment facilities reported waste data, with major consistency and quality assurance issues. Waste operators have to provide information about type of waste, treatment and weight as well as the waste's origin and planned treatment and destination. Waste is classified according to European List of Waste codes, and waste producers according to industry or NACE codes. Danish authorities use early checks and control systems to improve data quality and the EPA contacts each reporter individually to help improve reports. The country publishes annual waste statistic reports, which are available to the public.

ADS data are complemented by data from the Producer Responsibility System (DPA), for instance on WEEE and batteries. The DPA registers quantities of electrical and electronic equipment placed on the market.

Denmark carefully monitors transboundary movements, not only of waste that could pose risk to human health and the environment and waste that should be reported to Eurostat, but also overall waste shipments, including green-listed waste exported for recovery.

4.3.5. International co-operation and outreach

Denmark has established a range of good practices on waste, materials management and circular economy for other countries to learn from. For instance, the Kalundborg green industrial complex (Kalundborg Symbiosis, 2018[11]), a partnership of nine public and private enterprises that formed one of the first examples of industrial symbiosis around the Asnaes power plant, has been an inspiration for the design of eco-industrial parks around the world. The country has well-known research centres promoting best practices in waste management. Technical University of Denmark, for example, promotes life cycle analysis accounting for waste systems and provides software tools and training for waste managers (Dri, M. et al, 2018[12]).

The Danish Business Authority is a member of the Ellen MacArthur Foundation's CE100 Government and Cities programme to exchange best practices in the transition to a circular economy. The EPA has also contributed to this programme. Denmark was a pilot country for the foundation's work on a toolkit for policy makers (Ellen MacArthur Foundation, 2015[13]).

Denmark collaborates with other Nordic countries (Finland, Norway, Iceland and Sweden, along with the Faroe Islands, Greenland and the Aland Islands). Two working groups dedicated to waste management (Nordic Waste Group) and sustainable consumption and production were merged in 2019 to form a circular economy working group.

Denmark also has bilateral co-operation agreements on waste in the form of memoranda of understanding with countries including Turkey, Indonesia and Kenya. It is active in UN Environment's work related to implementation of the Basel Convention on the Control of Transboundary Movements of Wastes and Their Disposal. It is a contracting party to the 2009 Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships.

4.4. Promoting waste reduction and recycling

4.4.1. From incineration to higher recycling of municipal waste

Denmark has succeeded in diverting municipal waste from landfills using an efficient policy mix of regulatory and economic instruments (EEA, 2016[14]), such as the 1997 ban on landfilling waste that can be incinerated and the gradual increase of the landfill tax (Box 4.2). Policy instruments have been geared towards promoting waste to energy. While the third and fourth waste management plans helped divert waste from landfills, they were not as effective in promoting waste prevention and reduction or encouraging more recycling of household waste.

Box 4.2. Taxes on landfilling and incineration

Denmark introduced taxes on landfilling and incineration in January 1987 to create incentives to reduce the amount of waste sent to landfills and incineration and to increase recycling.

The landfill tax per tonne of waste gradually increased from DKK 40 in 1987 (EUR 5.3) to DKK 475 (EUR 64) in 2018 (PwC, 2018[15]). A refund is granted for waste later removed for recycling, so the tax is levied only for waste actually being disposed of. Revenue from the tax was originally earmarked for environmental protection but this is no longer the case. While the landfill tax, combined with a ban on landfilling combustible waste, was instrumental in reducing landfilling levels in the 1990s, it seemed to have limited effect on the amount of waste going to landfill and on recycling rates after 2001 (EEA, 2016[14]).

The incineration tax was replaced in 2010 by a tax based on the energy content of the waste. Nowadays a combination of taxes applies to waste incineration:

- The waste heating tax is based on the amount of heat produced from waste incineration, including heat used at the plant for indoor heating or water heating. In 2018 this tax amounted to DKK 19.80 (EUR 2.66) per GJ. It is coupled with an additional tax based on heating production according to the energy content of the input waste, which amounts to DKK 26.50 (EUR 3.56) per GJ. These two taxes ensure that the same energy tax rate is levied on heat whether it is generated from waste incineration or fossil fuels, which are subject to energy taxation.
- The CO_2 tax is levied per tonne of CO_2 emissions from waste incineration, except for waste loads containing pure biomass. By 2018 the tax amounted to DKK 173.20 (EUR 23.2) per tonne. In addition, most waste incineration plants take part in the EU Emissions Trading System (ETS), and pay emission allowances for heat and electricity production. Waste incineration plants are therefore subject to double regulation on CO_2 emissions.
- Taxes on emissions of NO_X and sulphur are imposed on some waste incineration plants. The tax on sulphur emissions is DKK 10.50 (EUR 1.41) per tonne, and that on NO_X emissions is DKK 5.10 (EUR 0.68) per tonne (PwC, 2018[15]).

Nowadays, the taxes on incineration seem mainly designed to ensure a level playing field in the energy sector while also helping divert waste towards recycling. However, there is no recent analysis on the impact of incineration taxes on recycling rates.

In 2010, a per tonne tax on hazardous waste treatment, both incineration and landfill, began being charged. In 2013, it was set at DKK 160 (EUR 21.45); in 2015 it was increased to the level for non-hazardous waste (NCM, 2014[16]).

Source: Country submission.

Recent pushes towards increased recycling seem directly driven by the introduction of mandatory EU recycling targets and reinforced by the adoption of the EU circular economy package in May 2018. This focus on recycling is starting to deliver in terms of performance, but risks causing financial losses to municipalities left with excess waste to energy capacity. In this context, despite a dedicated strategy for waste prevention, there are still limited incentives to address the high levels of waste generated.

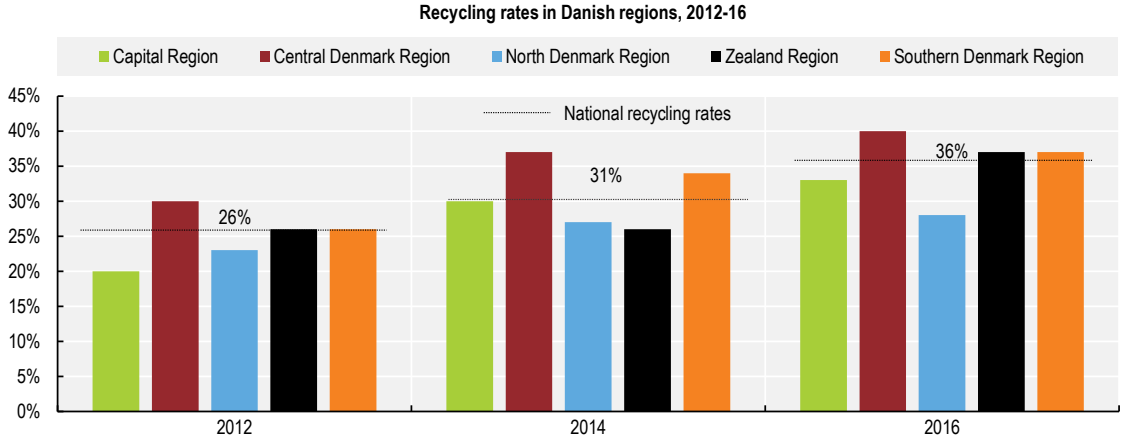
Towards higher recycling levels for municipal waste…

Denmark promotes recycling of municipal waste, starting with separate collection of recyclable waste. A 2009 statutory order on waste requires municipalities to establish separate collection of paper, cardboard and recyclable packaging such as glass, metal and plastic. In addition, municipalities have to follow the EU waste hierarchy when developing their 12-year waste management plans. They thus should give priority to prevention, preparing for reuse, recycling, recovery including energy recovery, and finally disposal. An increasing number of municipalities are setting up additional programmes for sorting other types of waste. For instance, between 2016 and November 2018, the number of municipalities with a system for source separation of organic waste grew from 22 to 40 (out of a total of 98).

Nevertheless, households' behaviour and contribution to waste sorting could still be improved. In 2014, only 60% of Danish respondents reporting separating waste for recycling, below the EU average of 72% (European Commission, 2014[17]).

Regional disparities in recycling performance can be observed. Central and Southern Denmark have more advanced recycling practices than North Denmark. However, the differences are minimal. Recycling of household waste is increasing in all Danish regions and particularly quickly in Zealand (Figure 4.10).

Figure 4.10. Recycling of household waste is increasing in all Danish regions



Source: EPA (2018), *Affaldsstatistikken 2016* [Waste Statistics 2016]; EPA (2017), *Waste Statistics 2015*.

StatLink http://dx.doi.org/10.1787/888934002414

To help municipalities exchange information on best practices, Denmark has set up a web platform (Genanvend, 2018[18]) focusing on household waste recycling. The platform gathers inspirational case studies (Box 4.3).

Box 4.3. Exchanging best practices among municipalities: Genanvend platform

As municipalities have important waste management responsibilities, they are key to the success of waste strategies. When the 2013 Denmark without Waste: Recycle More, Incinerate Less strategy was launched, municipalities required guidance and assistance to change their waste management methods.

At municipalities' request, a knowledge platform was set up with a dedicated website. Called Genanvend, which means "recycle", it includes technical reports and inspirational cases from municipalities as well as contact information to facilitate exchanges. It also includes the results of 80 projects financed by the EPA on household waste recycling.

In addition to the platform, a dedicated EPA team reached out to municipalities to animate the network and share information on waste collection and recycling.

As a result, an increasing number of municipalities started collecting separate household waste fractions such as plastic, cardboard and metal, and Denmark's household waste recycling rates for plastic, paper, cardboard, glass, metal, wood and organic waste are on course to meet the target of 50% by 2022.

Source: (Genanvend, 2018[18]).

The midterm evaluation of the waste strategy (EPA, 2017[19]) showed the country on track to meet its objective of increasing recycling of seven fractions of household waste to 50% in 2022. Recycling of plastic, paper, cardboard, glass, metal, wood and organic waste, considered jointly, rose from 22% in 2011 to 36% in 2016, the latest year for which data are available.

… and excess capacity for waste to energy

Converting waste to energy as efficiently as possible has long been a priority for Denmark, a pioneer in this regard. The first waste incinerator was built in 1903 in Frederiksberg, next to Copenhagen, as an innovative way to create steam and electricity for a nearby hospital. The construction of incineration plants was boosted in the 1970s with installation of district heating infrastructure following the oil crises and in 1997 with the introduction of the ban on landfilling waste suitable for incineration (DAKOFA, 2018[20]).

Today, the country is well equipped with waste to energy facilities. It has 23 waste incinerators (including 2 special facilities treating hazardous and other waste) and overall capacity of 4.3 million tonnes. Current waste incineration plants produce around 20% of the country's district heating and 5% of its electricity consumption (DAKOFA, 2018[20]).

The largest incinerator, operated by a publicly owned entity, Vestforbrænding, incinerated around 530 000 tonnes of household and business waste in 2016, leading to production of 1 166 000 MWh of heat and 254 000 MWh of electricity (Vestforbrænding, 2018[21]). The latest plant, in Amager Bakke, started operating in 2017 and has special features such as an artificial ski slope, a hiking slope and a climbing wall, making it a notable attempt to better integrate incineration into public space (Amager Resource Centre, 2018[22]). The plant, with capacity to treat some 560 000 tonnes of waste, replaces an older plant. Such incinerators are presented as a part of Copenhagen's ambition to become zero carbon by 2025.

As Denmark moves towards more recycling and less incineration, it is experiencing excess incineration capacity. This is problematic, as incineration costs increase significantly if less waste is processed than the plant was designed for.

Hence Denmark imports large amounts of waste for incineration, in particular refuse-derived fuel (RDF) from the United Kingdom, to operate plants efficiently. Imports for incineration increased from 267 000 tonnes in 2014 to 351 000 tonnes in 2016, when they accounted for about 10% of incinerated waste (EPA, 2018[23]) (Table 4.2).

Table 4.2. Imports of waste for incineration have more than doubled in recent years

Imports of waste suitable for incineration (thousand tonnes)				
	2013	2014	2015	2016
Germany	9	13	24	50
United Kingdom	98	231	307	276
Ireland	33	11	6	13
Norway	20	11	14	13
Total	160	266	351	352
Share of total waste incineration	5%	8%	10%	10%

Source: EPA (2018), *Affaldsstatistikken 2016 [Waste Statistics 2016]*.

Now the UK is extending its own incineration capacity, which could have a major impact on RDF markets. With neighbouring Germany, the Netherlands and Sweden also experiencing excess capacity, and price competition rising, there is a risk that some plants may be forced to close prior to the end of their expected lifespan (Brown, 2016[24]).

Other than disseminating good recycling practices, it is unclear how Denmark aims to help municipalities adapt to the changing paradigm (less waste, less incineration, more recycling). This is particularly important as municipalities own most of the waste management infrastructure – 90% of the 40 operating landfills and all 22 dedicated waste incineration facilities – whereas some 300 out of the approximately 350 recycling plants are privately owned. Waste incinerators have been mostly financed through public funding in the form of municipal loans from a special credit institution, Kommunie Kredit, with municipal guarantees.

Waste prevention and reduction efforts remain insufficient

While recycling of municipal waste is rising, prevention and reduction of household waste remains a critical issue. Indeed, the number of Danes reporting some waste reduction practice is falling. In 2014, 21% of Danes reported reducing waste by avoiding overpackaging or buying products with a longer life span, down from 28% in 2011 and below the EU average of 33% (European Commission, 2014[17]).

While Denmark has a policy of full cost recovery for municipal waste collection and management services (Box 4.4), municipalities are responsible for setting waste fees. Several municipalities operate pay-as-you-throw programmes with volume-based waste charges, which encourage waste prevention. Some municipalities have experimented with prepaid refuse bags (Dri, M. et al, 2018[12]).

Box 4.4. Municipal waste charges

A policy of full cost recovery for municipal waste collection and disposal services is embedded in Denmark's legal framework (Environmental Protection Act and statutory order on waste). Municipalities thus charge households and companies according to the cost of waste management services and cannot cross-subsidise waste management programmes. Those that charge an overall waste management fee to households must be able to break down the various types of service (administration, waste for incineration, dry recyclables, and hazardous, garden and bulky waste).

Within such a framework, municipal waste charges cannot be used to finance waste prevention activities and programmes.

Businesses located in buildings that also contain households may take part in the collection of dry recyclables and are charged separately for it. For other private companies, municipalities must offer access to at least one recycling station. The fee for such access can be paid per visit or by subscription. Municipalities may provide collection of waste for incineration, for which businesses would also pay a separate fee.

Businesses were formerly charged a municipal fee for administration (e.g. planning, regulation) relating to businesses. This fee was abolished in January 2019, mainly because the cost of administrating it (collection, exemptions and complaints) amounted to almost half of the revenue of the fee. The expenses paid by the fee is now financed through taxes.

Around 7% of household waste is avoidable food waste (247 000 tonnes in 2017). This issue is a priority of the waste prevention strategy. A partnership on reducing food waste by businesses, stakeholders and authorities was formed between 2014 and 2017 to identify possible solutions. A subsidy supported projects to reduce food waste in the food value chain through an awareness raising campaign called Check the Date in 2016 and 2018 to better inform people about food labelling. The Food Waste Hunters initiative in 2016-17 engaged with commercial food service kitchens sector on waste reduction opportunities. In 2016, the food donation rules were modified to facilitate such donations from businesses. These efforts are starting to have tangible results: it is estimated that Danish households reduced food waste by 8% per person per year between 2011 and 2017.

Plastic waste from households is another priority, although it represents a smaller fraction of household waste (134 000 to 198 000 tonnes in 2016, according to Plastic Europe, but estimates are uncertain). Denmark has several economic instruments to influence this waste stream and in 1993 was one of the first countries to require a fee for carrier bags (paper or plastic). The fee of DKK 22 (EUR 2.9) per kg helped halve consumption of plastic bags, but consumption is still around 445 million bags per year. Denmark also has a fee on single-use tableware (knives, forks, spoons, cups, plates and other items). The objective of both instruments is to influence consumer behaviour towards more durable alternatives. A fee on polyvinyl chloride (PVC) was abolished in 2019. The government published a Plastic Action Plan in December 2018 (Box 4.5).

Box 4.5. The Plastic Action Plan

The Plastic Action Plan was a government proposal that formed the basis for an all-party political agreement in Parliament in January 2019.

The political agreement includes a mix of measures, such as product bans, campaigns, voluntary agreements, research and innovation. It aims to promote waste prevention (e.g. through a ban on free plastic carrier bags and thin plastic carrier bags, and criteria on reducing single use plastic at public events), to increase plastic recycling and recyclability, and to both better understand micro-plastics in the environment and reduce the discharge of them by half.

Source: Country submission.

While waste prevention benefits from a dedicated strategy, waste reduction targets and instruments remain weak: there is no overall objective to reduce waste generation per capita or in absolute terms. Significant market and policy trends (chiefly excess incineration capacity and the focus on securing stable secondary raw material flows to boost recycling and biogas production) contribute to high levels of waste generation. Denmark should balance these trends with stronger incentives for waste prevention.

4.4.2. Extended producer responsibility and deposit-refund programmes

Denmark has several extended producer responsibility programmes mandated by EU requirements, and outperforms EU recycling targets in most instances. It established an independent entity, DPA-system (DPA System, 2018[25]), as a clearinghouse to manage the work of producer responsibility organisations (PROs). Aside from that, the involvement and steering role of public authorities in extended producer responsibility is limited. Enhancing design for environment via such programmes is seen as difficult.

WEEE and batteries

In accordance with EU directives, Denmark mandated extended producer responsibility for WEEE in 2006 and for batteries in 2009. For both waste streams, producers are responsible for the financial and organisational aspects of collecting and treating waste corresponding to their market share. Other obligations include labelling products, informing consumers on waste management, complying with the national producer register and reporting waste statistics. Producers can choose between managing their duties individually or joining a PRO to act on their behalf. They have to ensure that minimum collection, recovery and recycling targets are met. These are set in accordance with EU legislation.

While Denmark does not regulate or intervene in the business models of PROs, it has set up DPA-system as a clearing house to handle producer registration and monitor the amount of electronic and electrical equipment (EEE) put on the market and collected for treatment. Such a system is usually considered to be among OECD best practices, as it helps co-ordinate the PROs' work and ensure a level playing field for operators. It also ensures that collection is provided everywhere it is needed and that cherry picking of easily accessible or valuable WEEE is avoided. Producers pay a yearly administrative fee to DPA-system.

Of the four PROs operating in Denmark, two are private commercial entities (ERP Denmark and RENE) and two are non-profit associations with EEE producers on the board

of directors (LWF and Elretur). As municipalities are in charge of establishing collection points for WEEE and batteries, DPA-system allocates municipal sites annually to producers and PROs. Some PROs have established collection systems via retailers.

While Denmark far exceeded EU recovery/reuse and recycling targets in 2016 for WEEE and batteries (Table 4.3), collection rates were less impressive (48% of marketed EEE and 45% of batteries; the EU target is 45% for each waste stream). Collection of WEEE peaked in 2007 at 98 000 tonnes and has stabilised at around 72 000 tonnes per year since 2013 (Table 4.4).

Table 4.3. Denmark exceeds EU targets for recovery/reuse and recycling of WEEE and batteries

Waste electrical and electronic equipment, 2016

	Danish recovery rate (%)	EU target (%)	Danish reuse/ recycling rate (%)	EU target (%)
(1) Large household appliances	93	85	81	80
(2) Small household appliances	96	75	95	55
(3) IT & telecom equipment	96	80	94	70
(4) Consumer equipment and photovoltaic panels				
(4a) Consumer equipment	96	80	92	70
(4b) Photovoltaic panels		80		70
(5.1) Lighting equipment	95	75	94	55
(5.2) Luminaires	96	75	94	55
(6) Electrical & electronic tools	96	75	92	55
(7) Toys, leisure and sports equipment	96	75	94	55
(8) Medical devices	85	75	79	55
(9) Monitor and control instruments	97	75	95	55
(10) Automatic dispensers		85		80

Batteries, 2016

	Danish recycling efficiency, 2017 (%)	EU target (%)
Lead-acid batteries	79.1	65
Nickel-cadmium batteries	82.0	75
Other batteries (incl. button cells)	55.9	50

Source: Country submission.

As in other OECD countries, important WEEE flows are disappearing from official collection systems, especially WEEE of high value. In 2013, the Electronic Waste Collection Partnership was set up to enhance collection rates and map all flows of WEEE, including those not entering the official system. The partnership carried out several projects to estimate the amount of used EEE exported to third countries, amounts accumulated in society due to consumer behaviour, and thefts from municipal collection points and recycling sites. It is estimated that 50% of WEEE is collected outside the official system (MEF and MIBFA, 2018[7]).

To overcome such difficulties, the circular economy strategy and political agreement proposes allowing additional certified companies (which are in effect already operating on the market) to collect WEEE directly from households for reuse and recycling.

Table 4.4. Collection of WEEE has decreased and is stabilising

Generation of WEEE										
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Collected WEEE (tonnes)	60 245	98 308	77 627	84 399	82 931	84 319	76 200	72 080	71 557	72 482

Source: Country submission.

End-of-life vehicles

The extended producer responsibility programme for ELVs was set up in 2007 and applies to old and new cars sold in Denmark. Importers or manufacturers have to ensure that consumers can hand over their used vehicles to be treated in an environmentally sound manner free of charge. In addition, registration in the producer register handled by DPA-system is compulsory. Car importers have established a PRO called Refero to handle their producer obligations including reporting and information obligations.

The programme is complemented by a scrapping allowance (around DKK 2 200) paid when a used car is delivered to an approved car dealer. The allowance applies only to private cars and vans registered in Denmark after 1 July 2000. In 2017, Denmark restructured its taxation of cars to facilitate repair. A high registration tax is charged on all vehicles, including those that are put back on the market after major repair. Repair limits to determine if the registration tax is due will be gradually increased from 2018 to 2020 to facilitate repair. Denmark meets the EU reuse and recovery target of 95% for ELVs and has exceeded the 85% target for recovery and recycling (Table 4.5).

Table 4.5. End-of-life vehicles

	2006	2007	2008	2009	2010	2011	2012	2013	2014
ELV waste generated (tonnes)	99 354	98 249	101 173	99 515	104 866	100 816	114 392	128 869	118 597

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total recovery and reuse (%)	80	81.2	82.9	82.3	90.7	92.9	92.6	86.7	86.1	95	95
Total recycling and reuse (%)	80	81	82.7	82	90.5	92.8	92.4	86.6	86	90	89

Source: Country submission.

Packaging waste

Denmark achieves high levels of recycling and recovery of packaging waste and this waste stream is experiencing positive trends. Denmark has already met the 2030 recycling target of 70% included in the recent EU circular economy package (Table 4.6).

Table 4.6. Packaging waste recycling is increasing

Packaging waste												
%	2004	2005	2006	2007	2008	2009	2010	2011*	2012	2013	2014	2015
Recovery (%)	92	90	94	97	98	108	108	91	89	93	92	94
Recycling (%)	53	53	56	57	60	84	84	54	62	70	70	74

* Break in the series: in 2011, a new waste information system was set up.
Source: Country submission.

Denmark has applied a deposit system for refillable beverage containers since 1910. Since 2000, the system has been operated by Danskretursystem (The Danish Deposit System: Danskretursytem, 2018[26]), a privately owned non-profit organisation. In 2002, the deposit system was extended to some single use beverage containers (NCM, 2014[16]). The return rate of beverage containers covered by the system (beer, soda, cider, mineral water, lemonade and iced tea) is 90%. The country is well equipped with reverse vending machines. Operating fees paid by importers and producers make up 45% of the system's revenue and the resale of materials such as plastic, glass and aluminium accounts for 24%. Surplus revenue from deposit funds, which occurs when a beverage container is not returned to a store despite payment of the deposit, represents 29%. The new plastic action plan proposes extending the deposit system in 2020 to include juice and fruit drink concentrate bottles.

Denmark also applies a volume-based tax on packaging waste from several types of beverage container (wine, liquor, beer, mineral water, cider, soda with alcohol, fruit wine). Items included in the deposit-return system are taxed at a lower rate. While the country does not have an extended producer responsibility programme for packaging, it plans to develop one by 2025 as a requirement of the 2018 EU circular economy package.

4.4.3. Towards higher-quality recycling of construction and demolition waste

Construction and demolition waste makes up a majority of total waste generation (54%, including soil). EPA forecasts indicate C&D waste amounts could nearly double by 2030 (Deloitte, 2015[27]). Nearly half of domestic national material consumption is non-metallic minerals, including stone, gravel and sand extracted for construction activities. This makes C&D a key strategic sector for the transition to a circular economy.

Policy instruments to promote resource efficiency in the construction sector include a tax of DKK 5 per m^3 on volume of extracted raw material. The level is so low that it does not affect waste prevention, however. Denmark recovers most C&D waste (87% in 2016), demonstrating a long-standing effort to promote recycling for this waste stream and to limit contamination by substances of concern. The weight-based landfill tax and the ability to recover sorted, unpolluted and processed C&D waste without a permit under the Environmental Protection Act have been key factors in this regard (Deloitte, 2015[27]).

To limit contamination of the waste stream by substances of concern for health and the environment, the EPA supported studies and guidance documents for treating contaminated waste such as PCBs. Screening for PCBs is mandatory when demolishing or refurbishing a building dating from 1950 to 1977, to allow for separate removal and appropriate disposal of PCB-containing material. Such mandatory auditing and mapping of buildings or

structures to be demolished, dismantled or refurbished is considered a best environmental practice for C&D waste (Dri, M. et al, 2018[12]).

Despite high recycling rates, recovery activities are still low-value operations, mainly using crushed concrete and bricks to replace stone and gravel. To foster higher-quality recycling, Denmark is embarking on a circular agenda for construction, promoting reuse and selective demolition, and support initiatives to create momentum in this respect.

Mechanisms to mobilise stakeholders with public support have enhanced dialogue in the construction value chain (Box 4.6). The Danish Eco-Innovation Programme has funded several knowledge platforms and networks on sustainable construction as well as technology developments on waste prevention in the building sector and on C&D waste.

Box 4.6. Platforms to mobilise the construction sector on a circular economy agenda

- A partnership on sustainable construction and waste prevention was established in 2016 to foster collaboration between operators in the construction value chain, relevant authorities, and stakeholder organisations. It focused on practical solutions in two main areas: selective demolition and fostering an effective market for recycled building materials.
- The Knowledge Centre for Managing and Recycling Building Waste was founded in 2016 on the initiative of the Danish Construction Association. It is financed by MEF, the Landowners' Investment Foundation and Realdania, a private association in Denmark which supports projects in architecture and planning. The centre guides building owners, contractors, advisers and municipalities on recycling of C&D waste and on problematic substances in rebuilding, renovation and demolition. In January 2019, it was renamed the Knowledge Centre for Circular Economy in Construction.
- The advisory board on circular economy drew up the following innovative and ambitious recommendations for the building sector between autumn 2016 and summer 2017:
  - additional information requirements for amounts of reused, recycled and recyclable materials and for undesirable substances in new buildings and large renovation projects from 2020, with a voluntary sustainability classification system for buildings becoming mandatory in 2025
  - a standardised, freely available digital building passport, plus a product database for suppliers with digital factsheets for building products
  - a selective demolition plan to identify materials and the content of hazardous substances, assess materials' recycling/reuse value and specify demolition methods
  - public building procurement based on total costs and life-cycle calculations.

Several Danish stakeholder networks are active in the area of sustainable construction and management of C&D waste. Initiatives include:

- a network for construction waste established by the Danish Waste and Resource Network in 2012
- Sustainable Build, a collaboration between the Danish Industry Foundation and the Danish Architectural Centre to promote sustainable architecture.

The Danish construction industry established the Innovation Network for Sustainable Construction (InnoBYG), co-financed by the Danish Agency for Institutions and Educational Grants, to focus on knowledge sharing, networking and development in the industry in Denmark and internationally.

Realdania launched the "Circular Construction Challenge: Rethink Waste" in October 2018, calling for innovative ways to reuse, recycle and upcycle[1] waste for the built environment. The teams of architects and planners that come up with the best ideas for turning waste into a valuable resource through innovative use and design will receive substantial long-term development support.

Source: Country submission.

Among the various knowledge-sharing platforms and networks, the 2016 partnership on sustainable construction and waste prevention was instrumental in identifying practical barriers and common solutions to promote selective demolition and establish effective markets for recycled building materials. Stakeholders called for practical tools such as platforms to help match supply and demand, compilation of standards and guidance documents, demonstration projects focusing on cost, and more strategic use of green public procurement.

This paved the way for the advisory board on circular economy, which made several innovative and ambitious recommendations for the building sector. These included new information requirements for new buildings and large-scale renovation projects (on amounts of reused, recycled and recyclable materials), digital passports for buildings, mandatory selective demolition plans, and public procurement based on total costs during the life cycle of a building (Box 4.6).

Some were picked up in the national circular economy strategy, including a voluntary sustainability classification for buildings. The strategy is less ambitious on other aspects, however, such as mandatory information requirements and selective demolition plans. Instead, it notes that many companies fail to comply with existing requirements to sort C&D waste. Hence enforcement activities are likely to be strengthened.

4.5. Fostering the transition to a circular economy

Denmark has long paved the way for circular economy approaches by promoting sustainable consumption, eco-design, clean production and eco-innovation as well as green purchasing by the public sector. A 2015 study estimated that improving circular economy opportunities in five key areas (food and beverage, construction and real estate, machinery, plastic packaging and hospitals) could lead to an increase in GDP by between 0.8% to 1.4% and help create 7 000 to 13 000 jobs in Denmark (Ellen MacArthur Foundation, 2015[13]).

In September 2018, Denmark adopted the national circular economy strategy with its 15 initiatives. The focus is largely on how companies can drive the circular economy agenda, with measures to assist them (one-stop shop, access to financing, digitalisation). As part of its circular economy efforts, Denmark has also pledged to develop a bio-based economy, one based on using renewable biological resources to produce food, materials and energy. The construction sector has also been identified as a priority.

4.5.1. Promoting sustainable consumption and the sharing economy

Denmark has a long history of mechanisms to promote sustainable consumption through labelling and information campaigns. In 2012, it was estimated that 90% of Danish inhabitants knew about the Nordic Swan eco-label and 35% about the other official third-party verified label, the EU eco-label, and that 8 000 eco-labelled products were available. Not surprisingly, the share of Danes who say they buy eco-friendly products, at 48% in 2014, is second only to Sweden (60%) and trending up (from 39% in 2011) (European Commission, 2014[17]).

As part of the strategy on the sharing economy, citizens are encouraged to use sharing platforms with tax reductions on income from sharing activities. While most projects relate to use of assets such as car and lodging, some may have a more direct impact on waste management. For instance, on the meal-sharing platform, individuals can sell private meals as a P2P business model, and on a business platform called Too Good to Go grocery stores can sell food cheaply instead of throwing it out (B2C).

4.5.2. Promoting markets for recycling and secondary raw materials

The recycling market is characterised by small facilities handling materials such as glass, wood, plastic, construction materials, electronics, metal and textiles. Turnover of recycling activities in 2016 was estimated at DKK 4.8 billion and value added at DKK 0.9 billion. Apart from glass packaging, most recyclable waste is exported for recycling, especially cardboard, plastic, electronics and treated wood.

Municipalities and the private sector alike are considering expanding recycling capacity in Denmark. Many private operators claim, however, that they are holding back investment due to fragmentation of the recyclables market. While private recycling companies have access to commercial waste, municipalities have a monopoly for managing household waste and tend to favour their own facilities. Uncertainty regarding access to recyclable waste may thus slow down development in waste sorting and recycling and lead to suboptimal investment strategies, with some duplication of efforts between municipalities and the private sector. For instance, in Odense on the island of Funen (Fyn), a private company invested EUR 13 million to develop a recycling plant for food waste from supermarkets, separating the plastic for reuse and the bio-based content to produce energy. The Odense city council is planning a public tender to build and operate a similar plant to treat municipal household waste, which private operators say could duplicate and jeopardise the private investment.

In this context, the 2016 Utilities for the Future strategy proposes an in-depth reorganisation of the waste management sector by increasing competition for incineration and giving the private sector a greater role in waste collection and recycling. Discussions over practical implementation have stalled, however, and uncertainty may deter private and public investment for the circular economy. Another aspect under discussion as part of the circular economy strategy is the need to better harmonise collection of recyclable fractions of household waste to promote economies of scale.

4.5.3. Green public procurement

Denmark has developed a wide range of policy instruments to promote green public procurement. They range from regulatory instruments (mandatory purchasing rules) to voluntary initiatives and information campaigns (Box 4.7). A national smart public procurement strategy (Government of Denmark, 2013[28]) was launched in 2013, adapting and incorporating the EU indicative target of making 50% of all public tendering procedures green. In 2012, it was estimated that between 60% and 80% of public tenders included green criteria in Denmark, while their value was between 20% and 40% of the public procurement budget.

Box 4.7. Denmark has a well-developed strategy on green public procurement

- *Regulatory instruments:* Mandatory green public procurement rules are in place for timber, energy-using products and road transport vehicles.
- *Voluntary instruments:* The Partnership for Green Public Procurement is a free voluntary initiative that gathers 15 partners, including municipalities, regions and central authorities. Partners commit to adopt a green procurement strategy and common green procurement goals for product categories including building and construction, food, timber, information technology, paper and printing, and cleaning supplies. Purchasing criteria, including recyclability, recycled content and toxic content, have been defined for these categories. Together the partners account for 20% of Danish public procurement.
- *Information and knowledge sharing instruments:* The Responsible Purchaser website, for both public and private purchasers, gathers guidance and tools including the European Commission's green public procurement criteria and an EPA tool on total cost of ownership. An open platform called Forum on Sustainable Procurement disseminates knowledge and news on sustainable procurement and organises thematic working groups to discuss challenges and barriers to sustainable procurement.

The strategy has helped the country develop innovative tools to promote alternative business models for the circular economy and green purchasing, such as the EPA guidance on total cost of ownership. This tool allows public and private procurement agents to take into account the price of both initial purchase and operation. The EPA is expanding the tool to include the cost of waste disposal.

4.5.4. Promoting circular business models and innovation

While regulatory instruments on product design are an EU responsibility (related to product requirements and bans on substances of concern), Denmark has set up a wide range of other policy instruments to promote circular business models.

Information and dissemination of good practices include EPA publication of case studies on resource efficiency in businesses, for instance in the book Stronger without Waste. A web portal for small and medium-sized enterprises (SMEs), the Circular Company, was launched in September 2017. A one-stop shop on the sharing economy provides advice and guidance to companies and citizens on regulatory aspects. The circular economy strategy also envisages a single point of entry on the circular economy in general.

Subsidies and co-financing programmes are available to assist companies with development of products or circular business models and to provide education and training to SMEs. Circular economy projects can benefit from the main eco-innovation finance programmes, the Eco-Innovation Programme and the Green Investment fund. In addition, some grant and co-financing programmes are dedicated to the circular economy, such as Circular Business Model and Circular Business (Box 4.8).

In addition to information instruments and financing programmes, Denmark is attempting to use economic instruments to favour business models based on product reuse/recycling and discourage single-use products. For example, disposable tableware is subject to taxation based on volume (DKK 19.20 per kg).

Despite the wide range of initiatives, circular business practices are far from common among SMEs. A September 2017 survey of European SMEs on resource efficiency and green markets in the EU between 2015 and 2017 (European Commission, 2018[29]), Denmark reports the largest decline in SMEs declaring waste minimisation and companies recycling or reusing waste internally. In 2017, 49% of Danish SMEs declared that they minimised waste (the EU average is 65%) and 29% claimed to recycle waste internally (compared with the EU average of 42%).

Box 4.8. Support for circular economy innovation

Denmark has several financing programmes to support the transition to a circular economy in businesses, particularly SMEs.

- The Danish Eco-Innovation Program is a public subsidy programme supporting development and application of new environmental and resource-efficient solutions in selected priority areas, along with co-operation between companies and knowledge-based institutions. The 2018 budget was about DKK 86 million (EUR 12 million).
- The Danish Green Investment Fund (Danmarks Grønne Investeringsfond) is an independent state loan fund which co-finances economically viable projects to bridge the gap between traditional bank financing and equity capital (Chapter 3). It is open to private companies, non-profit housing associations and public sector companies and institutions (with budgets separate from municipalities, regions and the state).
- Circular Business Models (Cirkulære Forretningsmodeller) is a co-financing programme for SMEs to implement circular business models. It is co-ordinated with a partnership of business organisations. The budget for 2018-22 is EUR 15 million.
- Circular Business (Cirkular Forretning) is a grant programme for business organisations to help them train their SME members on circular economy.

Recommendations on waste, material management and the circular economy

Reinforce waste prevention as a key priority

- For household waste, expand pricing based on volume or weight – as in pay-as-you-throw programmes – while facilitating recycling and composting.
- Accelerate R&D on sorting and recycling technology and innovative reusable and recyclable materials (e.g. biopolymers).
- Develop policies to minimise output of single-use products, such as plastics.

Foster competition in incineration and better manage excess capacity

- Improve the cost-effectiveness of incineration by reforming municipal waste management, giving companies flexibility to choose where to incinerate their combustible waste and making public tenders mandatory for municipal waste incineration.

Continue efforts to steer the transition to a circular economy

- Harmonise criteria for sorting and collecting municipal waste fractions and consider unifying household and business recyclable waste markets to create economies of scale and encourage investment in innovation and large-scale recycling facilities.
- Foster circular product design by introducing eco-modulation of fees in extended producer responsibility systems, based on recyclability, reparability and reusability.
- Continue encouraging circular design by SMEs (e.g. through training and access to finance) and supporting companies in establishing take-back programmes and circular business models, e.g. with closed loops for products and materials.
- Promote voluntary agreements between business and government on circular economy, ensuring that the objectives go beyond what is required by law.
- Encourage voluntary initiatives and pilot projects to reduce "downcycling" (recycling that produces material of lesser quality and functionality than the original material) in the construction, textile and plastic sectors.
- Secure financing to develop data for circular economy (e.g. green accounts and material flow information for industry sectors).

Notes

[1] Upcycling can be defined as the process of recycling waste into new materials or products of better quality and environmental value.

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Chapter 5. Chemicals management

This chapter reviews Denmark's chemicals management framework, with a particular focus on industrial chemicals. It analyses pressures from chemicals on health and the environment in Denmark and the country's involvement in chemicals management at the regional and global levels. The Danish framework is part of the broader EU context, and a significant part of chemicals management is regulated at that level. This chapter does not focus on EU-level polices, but highlights Danish contributions to implementation and complementary activities at the national level.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

5.1. Introduction

The main drivers of Danish activity in the area of chemicals management include protection of the public (with a focus on consumers and vulnerable groups) and substitution of dangerous chemicals. They respond to major pressures for health and the environment from the use of chemicals in the country (e.g. reliance on imported goods, in particular products, along with low fertility and vulnerability of children and the elderly to chemical exposure). Synergy exists in the activities of the authorities, industry and society, and Denmark has a robust chemicals management framework. Some areas could benefit from further enhancement or improvement, as this chapter will show.

5.2. Pressures on health and the environment from chemicals

Denmark has a relatively small and export-oriented chemical industry. The number of hazardous installations has been relatively stable and the country faced few major accidents in the last decade. Denmark achieved significant emission reductions of greenhouse gases (GHGs), acidifying gases, air pollutants and heavy metals from industrial processes and product use. The country's system of chemical monitoring in the environment supports identifying its priorities in relation to chemicals management and efforts to address pressures from chemicals on health and the environment. Despite this, pressures persist (e.g. from endocrine disrupters and pesticides).

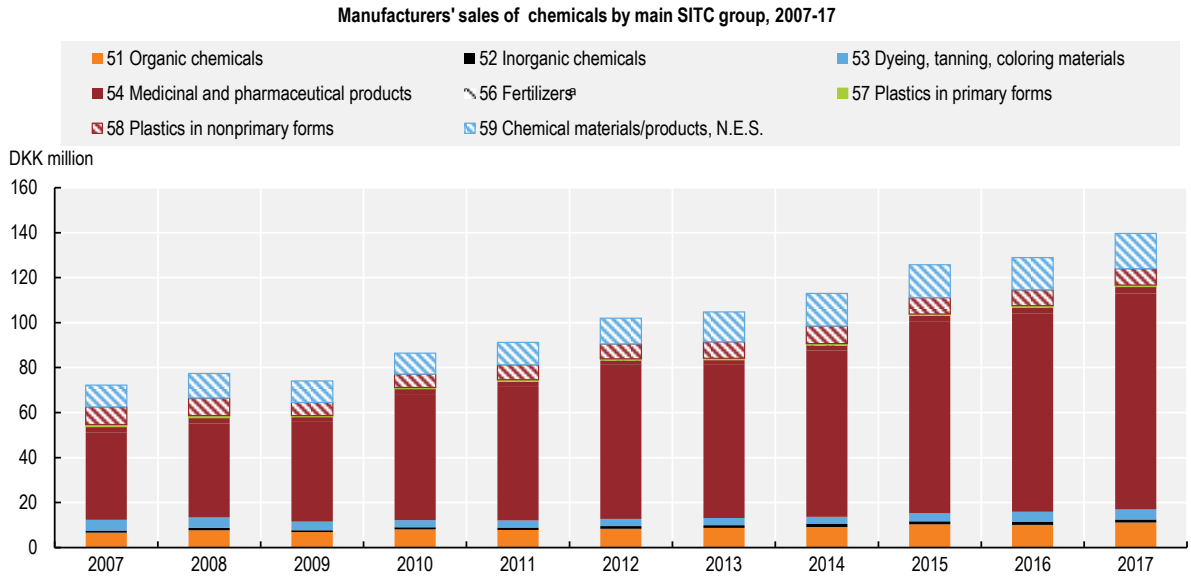
5.2.1. Chemical production and use

In 2016, the Danish chemical industry accounted for about 1% of the EU market. It consisted of 245 chemical companies with 11 400 employees and total turnover of EUR 5.5 billion. Danish companies' share of research and development within the EU chemical industry is higher at EUR 670 million or 3% (CEFIC, 2018[1]). Investment in the broad chemical sector (including pharmaceuticals, oil refining, rubber and plastic products and non-metallic mineral products) almost doubled in 2010 prices between 2007 and 2015. The chemical industry is largely export oriented: some 65% of production is exported and the broad chemical sector is the country's second largest export sector, after machinery and transport equipment. The Danish share in beyond-EU exports placed it at ninth place in 2017. The value of sales of chemicals and pharmaceuticals increased between 2007 and 2018 by over 90%, with the pharmaceutical sector as the main driver (Figure 5.1). The import and export of chemicals have shown fairly stable growth (except in 2009). Denmark is a net exporter of some chemicals (e.g. organic chemicals, chemical materials and products) and a net importer of others (e.g. inorganic chemicals, primary plastics) (Denmark, 2018[2]; Eurostat, 2018[3]).

Data from the national product registry, which covers not only manufacturers but also users of chemicals, show that the number of companies issuing chemical product notifications, the number of substances and products and total tonnage in 2015 did not differ substantially from 2005 (Denmark, 2018[2]).

Sales of pesticides and biocides (in tonnes/year) generally decreased by about 12% between 2007 and 2016 due to actions by the authorities to limit their use. A tax on pesticides introduced in 2013 resulted in stockpiling of certain pesticides and lower-than-usual sales in the following years. The lower sales may not be indicative of lower use over the short term (Ørum and Holtze, 2017[4]; Denmark, 2018[2]).

Figure 5.1. A pharmaceuticals boom stimulated growth in the chemical sector



Note: According to the Standard Industrial Trade Classification (SITC).
a) Exports include group 272, imports exclude group 272.
Source: Country submission; Statistics Denmark (2018), "Manufacturers' sales by main SITC group", *StatBank* (database).

StatLink http://dx.doi.org/10.1787/888934002433

Chemical facilities are spread relatively evenly around the country, but concentrated near the biggest cities: Aalborg, Aarhus, Copenhagen, Esbjerg and Odense. However, relatively bigger facilities are overwhelmingly located in the greater Copenhagen area (EEA, 2018[5]; Denmark, 2018[2]).

5.2.2. A stable number of hazardous facilities and visible efforts in reducing emissions of chemicals

The number of Danish installations classified as hazardous under the applicable EU legislation has been relatively stable. There are about 120, of which some 45% are upper tier installations (more hazardous) and some 35% fuel storage facilities (above the EU average of 11%, but in line with national policy to secure fuel supplies). Denmark expands the scope of application of the EU rules to also cover smaller installations (i.e. chlorine and ammonia installations), so the total number of hazardous installations is almost 140. Information on hazardous establishments is publicly available via a dedicated website (Denmark, 2018[2]; EMA, 2017[6]).

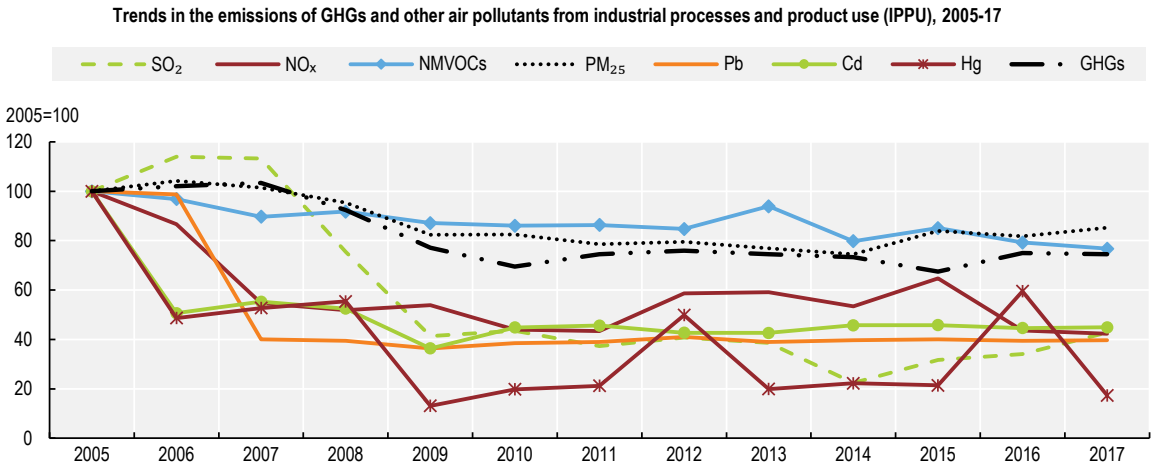
Since 2005, Denmark has reported only two industrial accidents to the e-MARS chemical accident reporting database; they resulted in one casualty and damage to a marine habitat (Denmark, 2018[2]). The biggest accident in recent times, an explosion in a fireworks storage facility, took place in 2004. Post-accident action led to enhanced enforcement and amendment of national legislation. Moreover, Denmark proposed enhanced standardisation at the European level (French Ministry for Sustainable Development, 2009[7]; EMA, 2017[6]).

The relatively stable number of major hazardous installations and low number of accidents suggest that measures to prevent major chemical accidents work relatively well in Denmark. Moreover, the country has a co-ordination forum for authorities to build on the

experience of accidents, which is working on dedicated web pages to support experience sharing (Denmark, 2018[2]).

Reducing emissions of chemicals is a strategic goal included in relevant legal and policy frameworks in Denmark. The Environmental Protection Act and Act on Chemicals set the overall goal of reducing pollution caused by chemical production and use, while national action plans include implementation measures (MEF, 2017[8]; Government of Denmark et al., 2017[9]). Denmark reduced emissions of GHGs[1] from industrial processes and product use by over 20% between 2005 and 2016. Significant reductions also occurred for acidifying gases, air pollutants and heavy metals[2] in industrial processes and product use and in manufacturing industries and construction (Figure 5.2).

Figure 5.2. Emissions from industrial processes and product use are generally on the decline



Note: IPPU consists of mineral industry, chemical Industry, metal industry, non-energy products from fuels and solvent use, electronics industry, product uses as substitutes for ozone-depleting substances and other product manufacture and use.
Source: Nielsen et al. (2019), *Denmark's National Inventory Report 2019*; EMEP (2019), *WebDab* (database).

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5.2.3. Despite monitoring of chemicals, pressures on health and the environment are significant

Denmark has a system of monitoring chemicals in the environment that supports identification of the country's priorities in relation to chemicals management. It includes a pollutant release and transfer register. Denmark has undertaken biomonitoring activities and co-operates with other countries in this field. Monitoring and biomonitoring results (Box 5.1) are publicly available.

Box 5.1. Examples of chemical monitoring/biomonitoring results that have helped shape Danish chemicals management priorities

- Studies showed that 40% of the male population had reduced semen quality; it is suspected that exposure to phthalates contributed to this result (EPA, 2013[10]).
- A cohort study of non-persistent environmental chemicals suspected of endocrine-disrupting properties concluded that nearly everyone in the population might be exposed to the monitored chemicals and that EU-wide restrictions had had a positive effect in Denmark. For instance, decreasing excretion of the phthalates DnBP and DEHP was observed following the introduction of restrictions on food contact materials and toys (Choi et al., 2015[11]; Denmark, 2018[2]; Frederiksen et al., 2014[12]). Increased public awareness contributed to decreased use.
- DEMOCOPHES revealed that Danes were widely exposed to PCBs (mostly from food) and PFAS (used, for example, in food packaging, non-stick coatings and textile coatings) (Choi et al., 2015[11]; Mørck et al., 2015[13]; Denmark, 2018[2])
- In the work of CEHOS, the effects of perinatal bisphenol A exposure on both male and female rat sexual development were identified at doses that could warrant a decrease in the tolerable daily intake of this substance (Bourguignon, Hutchinson and Slama, 2017[14]).
- Danish biomonitoring results were included in the restriction proposal for four phthalates jointly issued in 2016 by Denmark and the European Chemicals Agency (ECHA) (Denmark, 2018[2]).
- A 2012-15 initiative on better control of nanomaterials found, among other conclusions, that inhalation of nanomaterials might constitute a risk (Christensen et al., 2015[15]).
- In 2015, the Danish Environmental Protection Agency (EPA) requested an evaluation of health hazards from exposure to PFAS. This led to establishment of limit values for 12 PFAS in soil, drinking water and groundwater, and to further monitoring and screening activities (OECD[16])
- In 2016, pesticides and their metabolites were found in 34.3% of groundwater samples and in concentrations exceeding the quality standard of 0.1 ug/l in 8.6% of samples (reduced from 37.3% and 13.6%, respectively, in 2007). The data for 2017 showed a slight increase, but the data set differed significantly from previous years (GEUS, 2019[17]). This outcome led to actions at national level to expand the scope of monitoring.
- Concentration of zinc in agricultural soils increased by 19% between 1998 and 2014 and some 25% of streams had zinc concentrations above the environmental quality standard. The situation is expected to worsen due to the elevated concentration of zinc in manure from pig farming (Jensen and Bak, 2018[18]).
- National Allergy Research Centre research supported regulatory action on chromium in leather and methylisothiazolinone in cosmetics (Denmark, 2018[2]).

A key tool to monitor chemicals in the Danish environment is the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environment (NOVANA), established in 2004. It analyses pollution sources, trends, policy actions and environmental pressures in various categories (surface water, sediment, biota, groundwater, air and point sources, wastewater and rainwater installations), in particular to support compliance with Danish and EU legislation and international conventions. Since its inception, the programme has been adapted to evolving EU policies (e.g. Natura 2000, river basin management plans, emission ceilings). In the current monitoring period, 2017-21, it covers more than 250 substances in one or more categories and with varying monitoring frequency, e.g. 25 polycyclic aromatic hydrocarbons (PAHs), 13 per- and polyfluoroalkyl substances (PFAS), 20 metals, 17 polychlorinated biphenyls (PCBs), 8 plasticisers, 20 pharmaceuticals, and 66 pesticides and their metabolites. Denmark also monitors persistent organic pollutants (POPs) and heavy metal levels in the Arctic (EPA, AU and GEUS, 2017[19]; Denmark, 2018[2]).

As pesticide exposure remains a cause of concern, there are dedicated monitoring subprogrammes, including the National Groundwater Monitoring Programme and the Pesticide Leaching Assessment Programme. Denmark has also undertaken and supported efforts to address emerging issues of concern, such as the presence in the environment of antibiotics (antibiotic resistance was identified in 2017 as one of the country's four key risk challenges) and micro plastic (EUSBSR, 2017[20]; Løkkegaard et al., 2017[21]; Denmark, 2018[2]; EMA, 2017[6]).

As the country relies for its drinking water on groundwater that is not chemically treated (it is subject only to aeration and sand filtration), particular focus on enhanced monitoring is needed in this area. A key concern is so-called legacy pesticides (and their metabolites), no longer authorised for use in Denmark but found in groundwater sources.

Denmark would benefit from further enhancement of pesticide and legacy pesticide monitoring in groundwater and under the Pesticide Leaching Assessment Programme. It should also consider supplementing its actions with surface water monitoring (relevant for biocides), in line with the recommendations of its national expert-based water panel. In January 2019, Denmark announced that pesticide monitoring in groundwater would be expanded (MEF, 2019[22]), which should be applauded. Denmark should also consider enhanced monitoring of emerging pollutants (e.g. pharmaceuticals in surface and groundwater) and heavy metals (e.g. zinc in soil and water).

Biomonitoring

Denmark does not have a long-term biomonitoring programme for environmental chemicals like those in, for instance, Germany and the USA.[3] However, it is a one of the relatively few countries that have undertaken biomonitoring for non-occupationally exposed populations and it co-operates with other countries in this field within the EU framework. Both public and private sources, but mainly the latter, finance this work.

Denmark collaborated with 16 other European countries in the DEMOCOPHES project (DEMOnstration of a study to COordinate and Perform Human biomonitoring on a European Scale) on exposure to bisphenol A, other phenols, parabens, cadmium, cotinine and phthalate metabolites in urine, POPs in blood and mercury in hair. It also funded supplementary actions to increase knowledge of exposure of its population to potential endocrine disrupting chemicals (Mørck et al., 2015[23]; Denmark, 2018[2]). And it currently participates in the EU flagship human biomonitoring project, HBM4EU. Launched in 2017, the project aims to harmonise exposure assessment methods based on biomonitoring

data. In 2017, Denmark hosted a Nordic workshop to discuss priorities for the project (HBM4EU[24]; Knudsen and Hansen, 2017[25]). The Danish action plan on industrial chemicals (Section 5.3.1) includes biomonitoring in the context of endocrine disruptors.

An external evaluation of the Danish Centre for Endocrine Disrupting Substances (CEHOS) recommended in 2017 that the country should increase public investment in biomonitoring (Bourguignon, Hutchinson and Slama, 2017[14]). Denmark would benefit from enhanced biomonitoring, taking into account the trade-offs needed to balance it with predictive risk assessment to proactively identify chemicals that require regulatory action before a negative impact can be detected in humans or the environment. These actions should take into account a science/policy nexus, for instance supporting identification of the source of exposure or aligning the efforts with Denmark's regulatory priorities (e.g. under the EU REACH Regulation).

Consumers and workers

To ensure a high level of protection of the public (particularly consumers and workers) from risk related to chemicals, Danish research centres, supported by public resources, are undertaking activities to monitor and prevent risk in relation to:

- endocrine disruptors (CEHOS and the International Centre for Research and Research Training in Endocrine Disruption of Male Reproduction and Child Health)
- allergies to chemicals (the National Allergy Research Centre)
- the impact of chemicals on occupational health (Working Environment Research Fund) (Denmark, 2018[2]).

Pollutant release and transfer register

Danish companies have reported environmental information via so-called green accounts since 1995. In 2008, Denmark ratified the Kiev Protocol on Pollutant Release and Transfer Registers to the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters. It was implemented through the 2006 EU Pollutant Release and Transfer Register (E-PRTR) Regulation and national legislation. The EU/Danish PRTR covers 91 substances and some 65 economic activities. It includes 90 out of 126 chemicals from the OECD harmonised list of pollutants (OECD, 2014[26]). Danish reporting to the E-PRTR started in 2007 and to the Kiev Protocol in 2010. PRTR data are complemented by estimating emissions for substances with diffuse sources. Since 2012, geographical mapping of emissions from Danish diffuse sources in the PRTR has been publicly available (AU, 2018[27]).

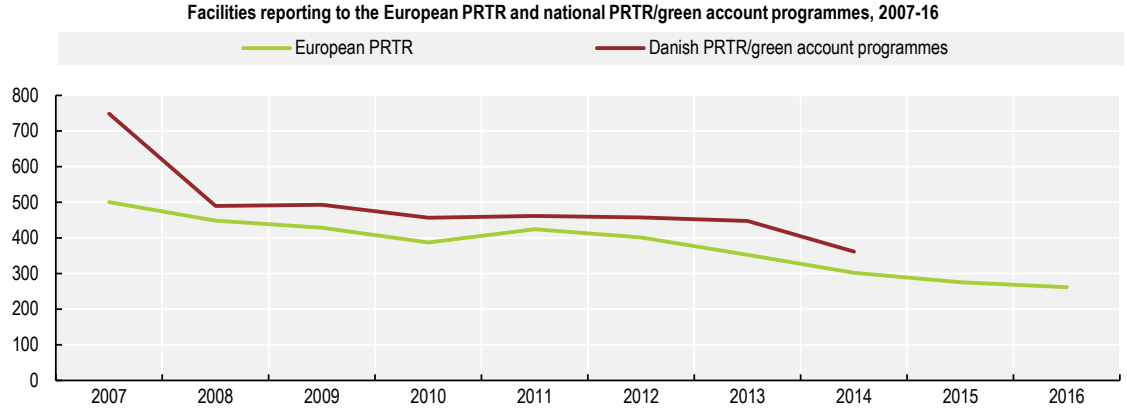
Companies report measured, calculated or estimated data annually to the PRTR, usually via a one-stop portal.[4] The EPA provides technical support. Companies, local authorities and the EPA contribute to data quality assurance. No overall assessment of the submitted data has yet done; such an assessment could help authorities understand the completeness and relevance of the data (MEF, 2016[28]). PRTR data are available to the public via the national PRTR register or the E-PRTR portal; national reports are subject to public consultation. Both registers offer a wide choice of search options (MEF, 2016[28]).

The scope of PRTR reporting was visibly reduced in the review period. Regulatory changes (modifying green account reporting in 2010 and abolishing it in 2015 in favour of a separate national regulatory framework for the PRTR) (EPA[29]) led to a reduction of the economic activities covered as well as strict application of E-PRTR scope and thresholds. The number of companies reporting environmental information in the green accounts and the PRTR fell

by 52% between 2007 and 2014; the number of Danish companies in the E-PRTR dropped by 48% between 2007 and 2016 (Figure 5.3) (EEA, 2018[5]; EPA[30]). The number of chemical industry facilities reporting dropped almost by half (from 49 to 25), mostly following the 2015 abolition of green accounts (EEA, 2018[5]; EPA[30]).

Fewer reporting companies means less information available for the authorities and stakeholders (e.g. companies and general public). This can contribute to the reduced ability of Denmark's PRTR system to provide comprehensive data on emissions that could support broader decision making.

Figure 5.3. The number of Danish companies reporting to the E-PRTR and national PRTR/green account programmes has fallen



Note: PRTR: Pollutant Release and Transfer Register. As of 2015, some installations reporting to the European PRTR, e.g. urban waste plants or offshore installations, are not included in the national PRTR/green account programmes (for which last available year for comprehensive data is thus 2014).
Source: EEA (2019), "Facility level", *E-PRTR* (database); EPA (2019), *Virksomhedssøgning* (Company Search) (database).

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5.3. Policy, regulatory and institutional frameworks

Denmark has a comprehensive policy and regulatory framework consisting of EU and national legal instruments, with national rules sometimes exceeding the EU rules' scope. Denmark manages all enforcement activities on chemicals at the national level and co-operates at the regional level in this field. Stakeholders are actively involved in chemicals management, and the use of economic analysis in decision making is on the rise.

EU membership had direct, comprehensive implications for the Danish legal system in the review period, for instance through introduction of the new EU horizontal legislation (applying to all chemicals not regulated by specific regimes) for industrial chemicals: the REACH Regulation and Classification, Labelling and Packaging (CLP) Regulation. However, the influence does not go just one way. Denmark has actively and rather successfully pursued its national objectives on chemicals both at the EU level and in a broader international context.

5.3.1. A comprehensive policy, legal and institutional framework is in place

Policies

Denmark has mainstreamed chemicals management into its national policy framework. Several high-level policy documents address chemicals management and reflect national

objectives and pressures. They take into account policy documents adopted at the EU level, notably the Environmental Action Programmes (EAPs).

General chemicals management

At the national level, since 2005 Denmark has prepared and implemented strategic policy documents related to general chemicals management. They take the form of four-year action plans, currently called the Chemical Initiatives. Negotiations between the government and main political parties outside government precede adoption of these policy documents. This approach secures a broad commitment from the political level, along with medium-term resources, to prioritise chemicals management. The current action plan covers 2018-21 (Box 5.2).

Box 5.2. Danish Chemical Initiatives 2018-21

The 2018-21 Chemical Initiatives, agreed by all parties in the Danish Parliament, build on previous plans and set the following priorities for national actions regarding chemicals:

- credible information to consumers on chemicals (with particular attention to chemicals in products, vulnerable groups, and food and food packaging)
- a level playing field for enterprises, particularly effective regulation of chemicals and good enforcement, with a particular focus on promotion of standard setting for Danish companies, better data quality, imported products, and support to SMEs
- initiatives on five groups of chemicals of concern – substances that are carcinogenic, mutagenic or toxic for reproduction; chemicals affecting brain development; endocrine-disrupting chemicals; allergenic chemicals; and chemicals of high concern for the environment
- research and knowledge building (in particular on endocrine disruptors).

The plan supports Denmark in meeting its obligations under the EU acquis on chemicals and the international agreements in this field.

Source: (Government of Denmark et al., 2017[9]).

Danish action plans on chemicals can serve as a best practice example. They have secured continuity and coherence of Danish priorities: focus on consumers, enforcement, implementation of EU legislation and support of international work. The priorities have been modified where activities did not yield the expected results. The action plans have reflected ongoing policy discussions (e.g. on endocrine disruptors or circular economy) and Danish reliance on imported products (e.g. focus on users of chemicals and imported products). They have also highlighted consumers' right to know and encouraged stakeholder involvement. The level of detail of the action plans has been enhanced over the review period.

The Chemical Initiatives have served as a guide for Danish efforts in the European and global arenas and as vectors to promote Danish knowledge and expertise. They have been aligned with and supported policy developments at the EU level, e.g. the EU EAPs and the Conclusions of the Council of the European Union (Government of Denmark, 2005[31]; Government of Denmark, 2010[32]; Government of Denmark, 2013[33]; Government of Denmark et al., 2017[9]). The Chemical Initiatives respond to the interests of various

stakeholders. For instance, in line with industry expectations, the current plan prioritises respecting growth and innovation when substituting hazardous chemicals (Danish industry, 2017[34]).

An area that might benefit from further improvement is chemicals' role in Danish policy documents on occupational health and safety (OHS). The 2011-20 OHS strategy only marginally addresses chemicals. This is surprising, given the important interface of EU industrial chemicals and OHS legislation, as well as the significant involvement of Danish OHS authorities in chemicals management in Denmark (Government of Denmark et al., 2011[35]). The 2019 political negotiations in Denmark on the strategy beyond 2020 offer an opportunity to improve this situation.

The first external evaluation of the Chemical Initiatives, in 2017, produced data that were not systematically gathered to evaluate the previous plans' effectiveness. As EPA staff were directly involved in preparation of the evaluation methodology, it should be beneficial for future assessments. The results also gave a clear signal for policy makers that evaluation should be a standard procedure. Indicators to better track progress of the action plans should be further developed and their use improved.

Pesticides

The first pesticide action plan was introduced in 1986. All strategic documents of the last ten years in this area share the same overall objective: limiting the use of pesticides and (from 2013) minimising the pesticide load on the environment and health (Government of Denmark and the Danish Peoples' Party, 2009[36]; ME, 2013[37]; MEF, 2017[38]).

The pesticide strategy for 2013-15[5] initiated a significant change in pesticide management, introducing a pesticide load indicator (PLI) based on the impact of individual pesticides on human health, nature and groundwater. This replaced a treatment frequency index, whose reduction targets had not been achieved. In addition, a differentiated tax based on the environmental and health burden, with the rate higher for pesticides with higher load, replaced a pesticide levy based on percentage of retail price (Box 5.3).

Box 5.3. Results of the 2013 pesticide load indicator reform are not yet fully known but appear promising

Pesticide load calculated on sales data (but not consumption) allowed Denmark to meet its goal of a 40% PLI reduction in 2016. Since the reform, pesticides with a greater load have largely been replaced with ones with a lower load (e.g. in cases of certain insecticides or growth regulators), which made it possible to meet the target on the most problematic substances in 2016. Moreover, the reform coincided with reclassification of chemical substances and mixtures in line with the EU CLP Regulation. In many cases, this led to stricter classification in relation to health hazards and heavier health loads.

The complete effects of the PLI reform on consumption were still not known in 2018, as farmers stockpiled pesticides ahead of the reform. The authorities need to monitor whether the reform negatively affects resistance to certain pesticides (e.g. antifungal resistance) due to, for instance, increased use of the least taxed pesticides. An action plan to address this, and to strengthen efforts to develop integrated pest management, will be implemented over 2019-22. Results of a research project to analyse how the tax reform changed farmer

behaviour are expected in 2019. Further discussion on the tariff changes is expected to follow in 2020.

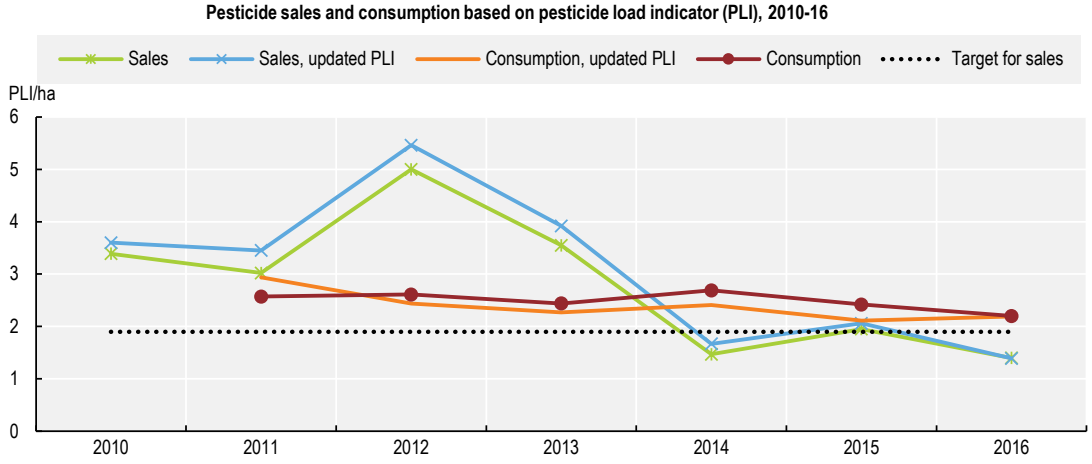
Measures to compensate farmers and gain their support accompanied implementation of the reform. These included reducing the land value tax and using tax revenue to support organic farming and administrative services.

Source: (Pedersen, 2016[39]; MEF, 2017[38]; Holtze, Kühl and Hyldebrandt-Larsen, 2018[40]; Denmark, 2018[2]; MEF, 2019[22]; Böcker and Finger, 2016[41]).

The new tax has four components: basic tax, health tax (with rates differing by health hazard), environmental toxicity tax (with rates differing by species) and a tax covering persistence, bioaccumulation and leaching. The major goal of the strategy was reducing pesticide sales, based on PLI, by 40% to a level equivalent to a pesticide load of 1.96 (Figure 5.4). It also included a 40% reduction target for the health burden of the use of carcinogens and hormone disrupting substances (ME, 2013[37]).

The pesticide strategy for 2017-21 has four main areas: pesticide authorisation; targeted and reinforced inspection efforts (focused on distributors); a pesticide research programme; and information, advice and guidance. The strategy serves as the National Action Plan for Sustainable Pesticide Use (MEF, 2017[38]). In January 2019, a supplement to the strategy was agreed. It contained additional measures regarding reduction of the risk of pesticidal contamination of groundwater in well vicinity protection zones, addressed pesticide resistance and banned (as of 2020) the sale of concentrated pesticides to non-authorised individuals. Additional measures and funding to strengthen monitoring of pesticides in groundwater were also agreed (MEF, 2019[22]).

Figure 5.4. A differentiated tax, introduced in 2013, helped reduce the pesticide load



Note: For the evaluation of the tax, data were recalculated for all the years with an updated database (e.g new classifications under the CLP Regulation) and updated data collection filters, especially the spray journal reports for the first years.
Source: Holtze et al., (2018), *Evaluering af den differentierede pesticidafgift* (Evaluation of the differentiated pesticide tax).

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Regulatory framework

The regulatory framework for chemicals management is comprehensive and addresses all relevant aspects. It consists of EU and national legal instruments.

In the last 13 years, the EU has substantially revised its legislation on industrial chemicals, in particular by adopting horizontal legislation, i.e. the REACH and CLP regulations. These rules have heavily influenced chemicals management in Denmark: on the one hand they imposed certain constraints (it was no longer possible to regulate some aspects of chemicals management at the national level), but on the other they provided new opportunities (e.g. making it possible to influence the EU-wide legal framework). There are also several EU regulations addressing more specific areas of chemicals management or groups of chemicals, such as those on cosmetics, detergents, and export and import of hazardous chemicals, POPs and mercury. In addition, EU directives addressing important areas of chemicals management include the Seveso Directive on major industrial accidents and the Industrial Emissions Directive.

At the national level, key Danish legal instruments related to chemicals management are the Act on Chemicals, the Environmental Protection Act and the Act on the Working Environment. They are the basis for executive orders issued to, among other things, transpose the relevant EU directives into the Danish legal framework or address areas of chemicals management that are beyond or outside of the scope of EU regulations and directives. For instance, the Danish regulatory framework requires companies to provide information on substances not covered by the REACH Regulation, e.g. produced or imported in amounts between 100 kg and 1 tonne (Denmark, 2018[2]). Pesticides and biocides are covered by both EU legislation (the Biocidal Products and Plant Protection Products regulations) and national rules (EC[42]; ECHA[43]).

In relation to prevention, preparedness and response to chemical accidents, Denmark expanded the scope of the applicable EU legislation to address smaller ammonia and chlorine installations as well. Denmark provides information on hazardous installations to other countries and exchanges information on accidents and near misses via the e-MARS database. Provision of information on hazardous installations to the public is also regulated, as is public participation in decision making (Denmark, 2018[2]).

An ongoing process of removing administrative burdens in Denmark, exemplified by a focus on avoiding over-implementation of EU regulations, has had some impact on the regulatory framework. It led to a significant reduction of the scope of reporting under the Danish PRTR and green account programmes and the removal of certain taxes on chemicals (e.g. phthalates) (Denmark, 2018[2]). This process has not affected the ambitious and well-resourced multi-year national action plans on chemicals or the areas of chemicals management where the country is a standard setter.

Institutional arrangements

At the national level, the Ministry of Environment and Food (MEF) is responsible for environmental protection in general and oversees and co-ordinates chemicals management, covering industrial chemicals, pesticides and biocides. MEF has a unit on chemicals and a unit on industrial regulation (MEF[44]). The EPA is responsible for implementation and enforcement of the vast majority of chemical legislation.

Participation in EU work on chemicals undertaken by the EU authorities has been enshrined in Danish policy documents since the enactment of the REACH, CLP and biocides regulations. It occurs at both the policy level (Council of the European Union) and the technical level, through ECHA and the European Commission (EC). MEF and EPA are the main participating authorities. For instance, EPA staff have worked on all of ECHA's main bodies: the Member State Committee, the Committee for Risk Assessment, the Committee for Socio-economic Analysis, the Biocidal Products Committee and the

Enforcement Forum and Management Board (of which Denmark has been a deputy chair since 2017), as well as several ECHA working groups (Denmark, 2018[2]).

Some chemicals management tasks are attributed to the Veterinary and Food Administration (VFA, monitoring food and feed for harmful chemical substances) and Agricultural Agency (AA, for fertilisers). Both are part of MEF. Important institutions not under MEF are the Working Environment Authority (WEA), which is part of the Ministry of Employment and is responsible for OHS; the Maritime Authority (MA); and customs. The Ministry of Health is involved on poisons and its research centres support the MEF/EPA work on chemicals. Finally, local authorities are responsible for certain tasks (Denmark, 2018[2]; EPA, 2015[45]). Those regarding chemical accidents are shared between the national Emergency Management Agency (EMA, under the Ministry of Defence), central and local environment authorities, and other authorities such as the police (Denmark, 2018[2]; EMA, 2017[46]).

The national institutional framework was modified in 2015 by merging the ministries responsible for environment and food (actions related to food were included for the first time in the 2018-21 Chemical Initiatives). In addition, the EPA is being relocated from Copenhagen to Odense, with some former EPA staff integrated into MEF.

As a majority of authorities responsible for chemicals are in the same ministry, co-ordination mainly takes the form of ad hoc intra-institutional consultations (or inter-institutional, for legislative procedures). Authorised access to registers and databases containing information on chemicals or installations (e.g. the Digital Environment Administration portal) supports information sharing among authorities. In some cases, the regulatory framework directly imposes co-operation among authorities (e.g. on major accidents or the REACH Regulation) (Denmark, 2018[2]; MEF, 2016[47]).

Financing chemicals management, performance measurement and cost saving

Denmark has multi-year action plans on chemicals (including biocides) and pesticides that guarantee stability of midterm funding. The Chemical Initiatives budget, for example, increased from some EUR 8.5 million for 2006-09 to some EUR 28 million for 2018-21. Between 2006 and 2017, this financing was highest in 2012-13 when activities under REACH peaked in relation to consumer products and information on chemicals. (Denmark, 2018[2]; Government of Denmark, 2005[31]; Government of Denmark et al., 2017[9]). Many chemicals management actions are undertaken and financed at the EU level, where Denmark contributes by transferring a percentage of its gross national income to the EU budget.

For 2018, the EPA had a total budget of some EUR 24 million for chemicals management. The main sources of funding were, in descending order, the action plans on chemicals and pesticides (29% and 37%, respectively, or 66% in all), fees for biocides and pesticides (21%) and the general budget (Table 5.1). The budget for pesticides is slightly higher than for general chemicals management. The pesticide action plan also contributes resources to the AA and VFA, and the budgets of other Danish institutions help fund actions on chemicals management (Denmark, 2018[2]).

Table 5.1. The EPA's 2018 budget for chemicals (DKK million)

	Chemical action plan	Pesticide action plan	Outside of action plans	Total
Industrial chemicals and consumer products	37.5		22.5	60.0
Biocides	7.4		13.5*	20.9
Pesticides (plant protection products)		59.4	25.2*	84.6
Chemical inspection	7.0	8.1	5.7	20.8
Agricultural Agency		3.0		3.0
Veterinary and Food Administration		5.2		5.2
Green labelling	1.0		0.5	1.5
Total	52.9	75.7	67.4	196.0

* This amount comes mainly from fees.
Note: The budget does not reflect the fact that in the organisational change some resources were moved to MEF but still allocated to chemicals.
Source: Country submission.

In 2018, the EPA had over 120 employees in chemicals management. Slightly more staff were involved in pesticide work (38%) than in general chemicals management (32%); some 17% worked in biocides and the rest in enforcement. Employees of other national authorities working on chemicals, management, particular in OHS (over ten persons), increase the number. Some work is outsourced: for instance, the EPA and VFA have a co-operation agreement with Technical University of Denmark to provide scientific advice on toxicological assessments and scientific research on safety of chemicals for human health (Denmark, 2018[2]; EPA, 2015[45]).

The human and financial resources secured by Denmark for chemicals management are encouraging. They support actions at the national level as well as in the international context, particularly within the EU. They also show that this area is a priority for the country. However, the EPA relocation process has triggered a visible turnover in staff, which entails risk in relation to institutional memory and current or planned activities when, for instance, new staff need to be hired and trained.

For industrial chemicals, a cost-recovery mechanism is essentially enshrined at the EU level, under the REACH and CLP regulations, rather than at the national level. Companies' fees, for registration of chemicals and application for authorisation, support covering the cost of services delivered by ECHA and national authorities. Part of the fee revenue is transferred to national authorities for work on substance evaluation, restriction proposals and authorisation applications (ECHA, 2017[48]). This cost-recovery mechanism may create challenges for the future, as it is likely to diminish after the last batch of REACH registrations in 2018. The EC stated in 2018 that implementing REACH required long-term financial and resource stability and greater national contributions in view of the diminishing fee income (EC, 2018[49]). As this could entail additional pressure on future Danish financial and human resources for chemicals management, it might be worth it to commence analyses on what form of enhanced contribution to ECHA's work would be in line with Danish priorities.

In relation to pesticides and biocides, it is the national authorities that charge the fees. Denmark charges annual fees on each authorised product (pesticides and biocides) and each place of sale (pesticides), as well as fees every three years for inspection of spraying equipment. These fees constitute a significant part of the Danish authorities' budget (Denmark, 2018[2]).

5.3.2. Compliance and enforcement need enhancement to meet Danish priorities on chemicals

Unlike many areas of chemicals management, where efforts are shared between the EU and its members, Denmark regulates and performs all enforcement activities in relation to chemicals management at the national level, including implementation of EU legislation. However, common EU efforts on REACH and CLP compliance are increasing. While the approach to inspections concerning industrial chemicals is generally risk-based, it is more systematic in regard to pesticides and chemical accidents.

The main Danish enforcement bodies are the Chemical Inspection Service (CIS, within the EPA), WEA and MA. CIS, with a staff of 17-18 persons, is responsible for industrial chemicals (including in electronics and toys), pesticides, biocides and cosmetics. The WEA is responsible for information obligations in the supply chain and for downstream users and OHS in general (including at offshore installations). The MA is responsible for chemicals related to obligations on ships. Some enforcement tasks related to chemicals management (e.g. on food) are attributed to other MEF agencies or other public authorities, particularly municipalities and customs (Box 5.4) (Denmark, 2018[2]; Dupont, Pelsy and Oulès, 2016[50]).

Box 5.4. A project to protect children from harmful chemicals shows potential for further work sharing and co-operation

As part of a broad initiative in 2013-16 to protect children from harmful chemicals, the EPA and customs conducted joint targeted border control actions. They built on an analysis of import volumes at various custom offices and used the relevant customs codes.

The results suggested that, while certain chemicals (e.g. heavy metals) can be effectively controlled at borders, compliance checks for most products in the retail chain can be just as effective if not more so. The main reason is that border controls do not prevent products from entering the market, as they are released following sampling, yet further actions (e.g. chemical analysis) may be needed to determine product compliance.

As the EPA plans to continue prioritising chemical import control and e-commerce, successful co-operation with customs (to be expanded to other stakeholders through the Danish Chemicals Forum) is expected. However, the above-mentioned results indicate more resources for enforcement in the supply chain may be needed to meet Danish objectives.

Source: (Denmark, 2018[2]).

Both informal and formal co-operation by enforcement authorities as well as joint inspections take place in Denmark. The enforcement authorities set their own inspection strategy. During the review period, some had a strategy that was not in line with the EU-wide strategy adopted by ECHA's Enforcement Forum (EPA, 2015[45]), but that situation was recently resolved (Denmark, 2018[2]).

The approach to inspections concerning industrial chemicals is risk based. In practice, this means complying companies can benefit from less frequent inspections, and enforcement focuses on certain geographical areas, particularly the capital region. Denmark makes its enforcement strategies publicly available. CIS focuses its activities on 15 to 18 targeted campaigns per year, plus response to complaints (some 400 per year). The WEA performs

general inspections in which all aspects of OHS are checked (Denmark, 2018[2]; EPA, 2015[45]).

For pesticides, enforcement takes the form of systematic supervision of companies introducing products to the market. As there are fewer of them than of companies dealing with industrial chemicals, the effects of enforcement are more tangible. For instance, increased inspections in relation to sale of illegal pesticides led to a sharp decrease in infringements, from 30% in 2016 to 10% in 2017 (EPA, 2018[51]).

Denmark participates in EU-wide enforcement activities, particularly regarding downstream users or consumers, in line with its approach to chemicals management. It also co-operates with other Nordic countries on inspections, with a focus on the EU legislation (EPA[52]; Kristiansen et al., 2018[53]).

The country carries out systematic appraisal of measures applied by operators of Seveso installations.[6] Almost all Danish upper tier installations have an external emergency plan prepared by the authorities (police and municipalities), which is above the EU average. However, testing of these plans has been an issue since 2003: it only took place for some 50% of installations due to an unclear division of responsibility. In 2018 the EPA published updated guidance material to aid authorities in addressing this issue (EC, 2017[54]; Amec Foster Wheeler, 2017[55]; EPA, 2018[56]).

Denmark has a dual system of penalties for non-compliance with chemical legislation. Heavy fines (proportional to income and applicable to legal persons) or a criminal sanction can be applied, but in practice, the authorities focus on preventive and educational actions. The most common enforcement tool is a warning; legal proceedings are rarely initiated (Denmark, 2018[2]; Rass-Masson, Blainey and Pelsy, 2010[57]; Dupont, Pelsy and Oulès, 2016[50]).

There are fewer inspections concerning industrial chemicals than in comparable EU countries (Dupont, Pelsy and Oulès, 2016[50]), which may be linked to potential differences in the scope of inspections and could become an issue in the long term. The results of recent enforcement campaigns related to chemical products (e.g. 80% of inspected hazardous mixtures sold online did not meet hazard information and labelling requirements) show that there is room for compliance improvement.

Additional efforts may be required in the future, in particular to cope with a priority area for Denmark: chemicals in products. Moreover, coherent and mutually supportive activities of all countries implementing the REACH and CLP regulations may be necessary, so Denmark could benefit from increased involvement in EU-wide activities. Beyond the EU context, product supply chains are becoming increasingly global, so global action will be needed. Danish stakeholders support enhanced enforcement (Danish industry, 2017[34]).

5.3.3. Exemplary public participation and involvement in chemicals management

Denmark actively involves stakeholders in chemicals management. Hence it is no surprise that Danes have the EU's highest level of trust in national authorities (Eurostat, 2018[58]). They also top the EU rankings for understanding and use of safety information on chemicals (e.g. safety instructions, warning symbols, labels). They consider themselves well informed about the risk posed by chemicals and feel that chemical safety has improved in last 10 to 15 years (EC, 2011[59]; EC, 2013[60]; EC, 2014[61]; EC, 2017[62]).

At the national level, Danish stakeholders can take part in the public consultation mechanism employed during legislative discussions. A Special Government Committee for the Environment, open to all organisations with an interest in environmental matters, is consulted on the Danish position in the EU and other international forums, and non government organisations (NGOs) are occasionally included in Danish delegations to international negotiation meetings (Denmark, 2018[2]). Improved, formalised dialogue with the industry has been an inherent part of the Chemical Initiatives. The creation of the Danish Chemicals Forum in 2014 strengthened stakeholder engagement in the chemicals area. The forum groups representatives from public authorities, industry, labour, NGOs and academia and focuses on dialogue, co-operation, knowledge and dissemination of information on chemicals management (Sørensen et al., 2017[63]). Stakeholder bodies are also in place for biocides (the Biocide Panel) and pesticides (the Pesticide Dialogue Forum). All meet a few times a year. MEF also meets regularly with stakeholders from the Danish cosmetic and toy sectors. Dedicated chemical events for stakeholders include Chemistry Day, organised annually since 2005; the 2018 edition focused on sustainable chemistry in the future (Denmark, 2018[2]).

The public has access to non-confidential information on chemicals and has been the target of a vast number of initiatives, heavily supported by communication activities. The current Chemical Initiatives highlight the strategic importance of ensuring that consumers receive honest information about risks related to chemicals (whether in substances, products or food) so they can make informed choices.

To increase awareness about hazardous chemicals and chemical exposure in the general population, and contribute to EU and OECD work, the EPA has undertaken information campaigns on chemicals in consumer products. Particular attention has been paid to vulnerable groups such as children. Another example is correct pesticide use. The EPA has published an exemplary amount of information on chemicals for consumers, including, since 2001, over 160 studies on everyday products such as toys, furniture, clothing and sport equipment. It has prepared educational material for school-age children. Since 2013, it has run a Facebook account called Hverdagskemi (Everyday Chemicals) to advise on safe use of chemicals (Denmark, 2018[2]). In September 2018, a website on chemicals in consumer products and food, bridging information from the EPA and VFA, was launched (EPA, 2018[64]). Stakeholders are often involved in these activities.

Many other awareness-raising activities are directed towards supporting industry compliance with regulatory measures (EPA, 2015[45]). Thematic national and international workshops have been organised to promote knowledge sharing on chemicals of particular interest for Denmark, such as endocrine-disrupting chemicals (EDCs) (OECD, 2010[65]; EPA[66]). Danish authorities support NGO work related to chemicals management and co-ordinate activities with them to build synergy (Government of Denmark et al., 2017[9]). For instance, the EPA and Danish Consumer Council launched a smartphone application to give consumers information on hazardous substances in products (Box 5.5) The same NGO launched THINK Chemicals, an initiative to test consumer products (e.g. earphones, diapers, cosmetics, chewing gum, cleansing tissues), in co-ordination with the EPA (Danish Consumer Council[67]).

Box 5.5. Denmark is at the forefront of best practices stimulating public involvement in chemicals management

In 2014, the EPA and Danish Consumer Council launched a mobile app called Tjek Kemien (Check Chemicals) enabling consumers to scan products for information on whether they contain substances of very high concern (SVHCs) under the REACH Regulation. It increased consumers' awareness of their right to information on hazardous chemicals in everyday products. This experience and that of Germany, which launched a similar app, led to discussions on developing such an app at the EU level. It is being developed under the AskREACH project funded by the EU's LIFE Programme, with Danish stakeholder participation). It is expected to be launched in 2019.

Sources: (Sørensen et al., 2017[63]; ECHA, 2015[68]; Chemical Watch, 2017[69]; Chemical Watch, 2018[70]; LIFE AskREACH, 2018[71]).

5.3.3. Increasing the use of economic analysis in decision making

Economic analysis in relation to decision making (including chemicals management) is built into the legislative framework at both the EU and national levels. At the national level, due to the growing importance of the horizontal EU legislation on chemicals, economic analysis has been increasingly used, particularly to influence EU-wide decisions and policies (e.g. in the work of ECHA technical committees). It was also influenced by studies showing the pressures from chemicals on Danish society.

For instance, a high prevalence of male reproductive disorders, in comparison with neighbouring Finland, and a decline in the onset of puberty in girls have been observed in Denmark, with EDCs being identified as a potential factor (Krysiak-Baltyn et al., 2010[72]; Mouritsen et al., 2010[73]). It has been estimated that exposure to EDCs in Denmark leads to total yearly health and economic costs of more than EUR 2 billion (some 1.3% of GDP, which is above the EU average) (Trasande et al., 2016[74]). There are also statistically significant healthcare costs and productivity losses for adults with contact dermatitis. The socio-economic costs of contact allergies have been estimated at EUR 2.4 billion per year (Saetterstrøm, Olsen and Johansen, 2014[75]; Sørensen et al., 2017[63])

Denmark has begun evaluating the effects of its action plans on industrial chemicals. The 2017 *ex post* evaluation of the 2014-17 Chemical Initiatives, for example, assessed their qualitative and quantitative impact by identifying the overall goals and later establishing effect chains[7] for each of the 14 actions. In effect chains, inputs, activities, outputs and effects are combined to explain how and why a given planned activity should lead to the desired effect. The analysis by external consultants and the EPA suggested, among other things, that the environmental and health benefits of the actions over the long term (50 years) would outweigh the costs in all scenarios, with benefits ranging from EUR 27 million to EUR 1.2 billion. An *ex ante* analysis of the 2018-21 Chemical Initiatives, mainly establishing the framework for a future *ex post* evaluation, followed in 2018. It recognised the use of the effect chains developed in principle for the *ex ante* evaluations (Denmark, 2018[2]; Sørensen et al., 2017[63]).

Other public authorities in Denmark that have employed economic analysis in their work include the VFA, which in 2013 produced economic impact assessment tools for its staff to support cost-benefit analysis of its policy measures, and the EPA, which used economic

analysis to estimate the pesticide tax's impact on agricultural producers (Sørensen et al., 2017[63]; Holtze, Kühl and Hyldebrandt-Larsen, 2018[40]).

5.4. International forums and regional settings

Denmark has long been at the forefront of global and regional discussions on chemicals management and has prioritised international co-operation in national strategic documents.

5.4.1. Multilateral environmental agreements and international organisations

Denmark actively participates in the multilateral environmental agreements (MEAs) and non-binding initiatives on chemicals, and contributes to international organisations' work. It is a party to all relevant chemical MEAs (e.g. the Minamata Convention on mercury, the Rotterdam Convention on prior informed consent, the Stockholm Convention on persistent organic pollutants) and to regional agreements in the UNECE framework, including the Helsinki Convention on transboundary effects of industrial accidents and the Kiev PRTR protocol. Danish implementation is usually through laws transposing the applicable EU legislation (Denmark, 2018[2]).

Among non-binding global initiatives on chemicals, Denmark has implemented the Globally Harmonized System of Classification and Labelling via the CLP and REACH regulation (the latter in relation to safety data sheets). It is active in the Strategic Approach to International Chemicals Management (SAICM), including involvement in and support for the SAICM Beyond 2020 process (EPA, 2018[76]).

Denmark has provided both in-kind and financial support to the work of international organisations involved in chemicals management, particularly in areas aligned with its national priorities, such as EDCs. Over the review period, Denmark continued to be one of the top 15 contributors to the Environment Fund of UN Environment (Denmark, 2018[2]; UN Environment, 2018[77]; Urho et al., 2019[78]). Finally, Denmark contributes to the OECD work on chemicals: it chaired the Joint Meeting of the Chemicals Committee and Working Party on Chemicals, Pesticides and Biotechnology in 2015-17, and continues its participation in that body and its working parties and groups.

5.4.2. Regional and bilateral co-operation

Although co-operation within the EU (see Sections 5.5 and 5.6 for Denmark's contribution to chemicals management at the EU level) has become more important for Denmark, in line with the evolution of regional legislation on chemicals, it has not completely replaced other modes of regional involvement. They continue to exist, as do bilateral initiatives.

Nordic co-operation

Important regional co-operation on chemicals takes place within the Nordic Council of Ministers, an inter-governmental co-operation forum comprising Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland and the Åland Islands (Norden[79]). The main vector for co-operation on chemicals is the Nordic Chemical Group, whose overarching goal is "sustainable development based on high-level health and environmental protection for both the present and future generations" (Norden[80]).

For over 30 years, the group has co-ordinated members' activities to support national efforts on chemicals management. Its 2019-24 priorities include supporting substitution of hazardous chemicals; strengthening EU regulations on grouping of hazardous substances;

co-operating on supervision of chemicals in articles, in recycling and in e-commerce; and paying special attention to the presence and impact of chemicals in northern regions and the Arctic (NCM, 2018[81]).

Arctic region

The Arctic Council is a co-operation forum comprising Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States, along with Arctic indigenous communities and other inhabitants. Of particular importance for chemicals management are its:

- Arctic Contaminants Action Program
- Arctic Monitoring and Assessment Programme (AMAP)
- Emergency Prevention, Preparedness and Response Working Group (AC[82]; Denmark, 2018[2]).

Denmark is very active in the work concerning the region (for instance, in AMAP), particularly due to its ties with the Faroe Islands and Greenland (Box 5.6).

Box 5.6. Continuing co-operation in the Arctic is important

The Kingdom of Denmark consists of Denmark and the territories of the Faroe Islands and Greenland. The territories face serious environmental challenges. For instance, Denmark's 2017 National Risk Profile identifies increased activity in the Arctic region as one of four challenges for the kingdom and calls for greater commitment to maintain effective civilian preparedness throughout the realm.

A common policy document of Denmark and the territories, Strategy for the Arctic 2011-20, underlines the importance of monitoring the Arctic environment and protecting it from such hazardous substances as POPs and mercury. It also highlights focusing on national implementation of international environmental agreements and on prevention of accidents involving chemicals. Denmark and its territories co-operate on chemicals management, for instance through long-term monitoring of POPs and heavy metals in Greenland and related human health effects in Greenland and the Faroes. About half of Danish funding for research and monitoring in the Arctic is devoted to chemicals. The results support Danish activity at the EU level (e.g. under the REACH Regulation) and internationally (e.g. under the MEAs).

Sources: (Prime Minister's Office[83]; Denmark, 2018[2]; Governments of Denmark, Greenland and the Faroe Islands, 2011[84]; EMA, 2017[6]).

North-east Atlantic Ocean

Denmark co-operates with 14 European countries and the EU within the OSPAR Commission under the OSPAR Convention.[8] The goal of co-operation on chemicals is to prevent pollution by reducing discharges, emissions and losses of hazardous substances. The Hazardous Substances & Eutrophication Committee implements OSPAR's Hazardous Substances Strategy, for instance via assessments of substances of concern for the maritime environment, regional data collection and co-ordinated monitoring. This work complements and supports the work of the EU and international organisations (OSPAR Hazardous Substances & Eutrophication Committee, 2018[85]).

Baltic Sea

Denmark co-operates on chemicals in the Baltic Marine Environment Protection Commission, HELCOM,[9] whose aim is to protect the Baltic Sea marine environment from all pollution sources. On chemicals, the main goal is for the Baltic to be undisturbed by hazardous substances (HELCOM[86]). The work includes co-operation on environmental monitoring and reduction of inputs of hazardous substances to the Baltic Sea. Denmark led the project on risk of oil and hazardous substance spills in the Baltic Sea and is a lead country for developing the core indicators for "PAH and their metabolites" and "TBT and imposex" (HELCOM, 2015[87]; Denmark, 2018[2]). In 2018, Denmark signed a regional declaration whose commitments included jointly re-examining the effectiveness of measures and recommendations for legacy pollutants, identifying the scale of problems of contaminants of emerging concern, identifying and assessing further hazardous substances and contaminants from offshore sources, and developing appropriate mitigation measures (HELCOM, 2018[88]).

Bilateral co-operation

In 2014, EPA signed a bilateral agreement with the Swedish Chemicals Agency on co-operation in the EU context, e.g. on chemicals in consumer products and on EDCs. It aims to support information exchange and experience sharing (Denmark, 2018[2]).

5.5. Systematic investigation of chemicals

Since 2007, the REACH Regulation has set the framework for systematic investigation of industrial chemicals at the national and European levels. Denmark actively contributes to priority setting and assessment processes at the EU level and to identification of chemicals of concern.

5.5.1. Gathering, exchanging and protecting information on chemicals

Several chemical inventories at the EU level contain information provided by Danish companies. Examples include the database of substances registered under the REACH Regulation, the ECHA classification and labelling database (C&L Inventory), and databases on biocides and pesticides. Non-confidential information from these is publicly available, while the confidential part is accessible to authorised EU and national authorities (ECHA[89]).

Denmark complements the EU inventories with its own databases. The Danish Product Registry, run jointly by the WEA and EPA, covers low-volume hazardous substances (of which between 100 kg and 1 000 kg is manufactured or imported per year) and mixtures (more than 100 kg produced or imported per year) placed on the market for professional use; biocides not yet covered by the authorisation system; and offshore chemicals. The registry contains information on about 38 000 registered products (WEA[90]). The Danish Nanoproduct Register (whose data are accessible only to the Danish authorities) gathers information on mixtures and articles containing nanomaterials (EPA[91]). Denmark also has a database of chemicals in consumer products (EPA[92]); a database of pesticides and biocides, including information on cancelled, rejected or expired authorisations (EPA[93]); and a database of advisory self-classifications (EPA[94]).

Exchange and protection of chemical data

Several mechanisms enable the exchange of various types of information on chemicals between Denmark, other countries and regional and international bodies. They serve

mainly to facilitate work at the EU level (e.g. confidential information is exchanged between ECHA, national authorities and industry) (Denmark, 2018[2]). In addition to EU data-sharing mechanisms, Denmark exchanges non-confidential information on chemical products with other Nordic countries and provides information to international bodies, for instance through reporting under MEAs, SAICM and AMAP (Denmark, 2018[2]).

Confidentiality provisions are part of the national and EU legal framework. For instance, information in the Danish Product Registry is protected to ensure that companies can only gain access to their own confidential information (Denmark, 2018[2]).

5.5.2. Involvement in assessment of chemicals

Priority setting and assessment

Priority setting for industrial chemicals is in principle done at the EU level but in practice is a joint effort of the EU and national authorities. The Community rolling action plan (CoRAP) lists prioritised substances for evaluation. ECHA and the national authorities identify substances that could be included in CoRAP and subsequently evaluated by the national authorities (ECHA, 2018[95]; ECHA, 2018[96]). The EU legislation directly applicable to Denmark lays out a process for hazard, exposure and risk assessment of industrial chemicals, as well its timeline. Box 5.7 provides an example of the approach to chemical assessment in a non-EU OECD country: Australia.

Box 5.7. Assessment of industrial chemicals: The Australian perspective

Australia introduced the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework in 2012 to accelerate assessment of industrial chemicals and complement the work done in the Priority Existing Chemicals (PECs) process. This science- and risk-based framework is used to identify and rapidly assess existing chemicals of concern. It is also used to enhance risk management of industrial chemicals by increasing the flow of chemical safety information to industry, risk management bodies and the public. IMAP has extensively used assessments performed abroad, particularly in Canada, the United States and the EU.

The number of industrial chemicals on the national inventory considered in the IMAP framework is significantly greater than the number considered in the PEC process: more than 12 000 chemicals were assessed between 2012 and 2018. The framework reduced the gap of unassessed chemicals from 92% to 61%. It has been used to identify environmental contaminants of emerging concern and has raised awareness of the need for risk reduction strategies for high concern chemicals.

The accelerated rate of assessment of industrial chemicals achieved using the IMAP framework relies on a tiered approach in which chemicals are assessed at a level corresponding to their potential risk to human health or the environment. In 2016, the assessment focus shifted from identification of concerns (IMAP stage 1) to de-prioritisation (IMAP stage 2) (see Chapter 5 of the 2019 OECD Environmental Performance Review of Australia for further information). The human health and environmental assessments are often conducted separately, which allows resources to be efficiently allocated to addressing areas of concern.

Under IMAP, chemicals are frequently assessed in groups, using OECD principles for building chemical categories, and a weight-of-evidence approach is used to consider relevant, reliable data from domestic and international sources. A comprehensive

Quantitative Structure-Activity Relationship strategy, including custom-built tools, was established to support decision making. A significant investment was made in developing chemical informatics software that enables rapid assessment and maximises the use and reuse of the large amounts of quality-assured regulatory information generated in assessments.

Once the Australian National Industrial Chemicals Notification and Assessment Scheme reform enters into force, it is expected to replace both the PECs process and the IMAP framework with a new legislative tool.

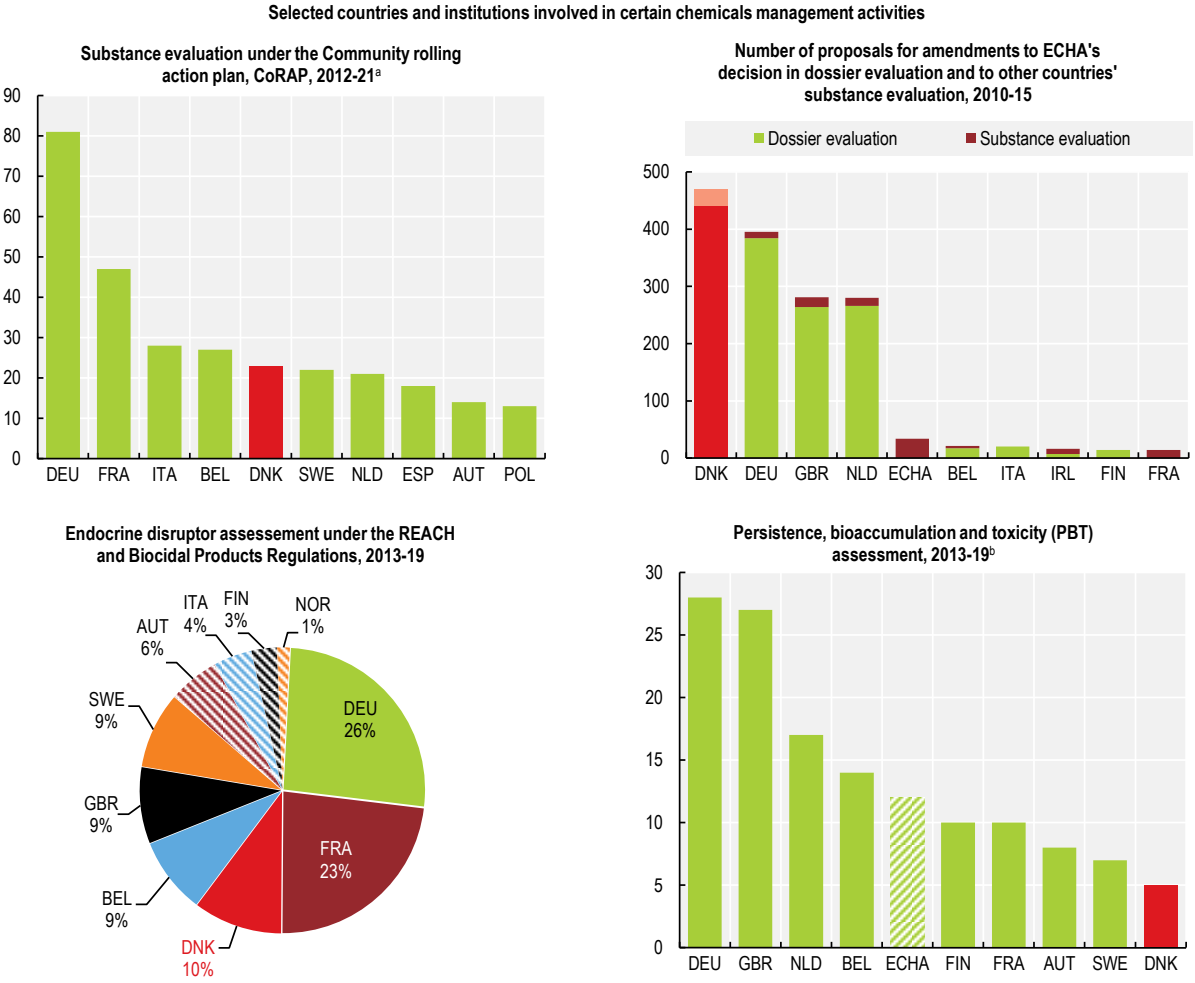
Source: (Australia, 2019[97]; OECD, 2019[98]).

Denmark has actively contributed to priority setting and assessment processes at the EU level (Figure 5.5). Danish priorities for selecting chemicals are set in a multi-year action plan on chemicals and have been relatively stable over the last decade. The current Chemical Initiatives prioritise actions in relation to carcinogenic, mutagenic or toxic for reproduction (CMR) substances; chemicals affecting brain development; EDCs; allergenic chemicals; and chemicals of high concern to the environment (Government of Denmark et al., 2017[9]).

Denmark has been especially active in estimating properties of chemicals from their molecular structure using results of SAR or QSAR modelling, known collectively as (Q)SARs. The National Food Institute at the Technical University of Denmark, supported by the EPA, NCM and ECHA, launched a publicly available (Q)SAR database with estimates from more than 200 (Q)SARs and (Q)SAR predictions for more than 600 000 chemical substances. It is part of the OECD QSAR Toolbox (NFI[99]).

The country has been involved in investigating chemicals outside the EU framework, for instance under the Helsinki and OSPAR conventions. It has actively participated in development of the OECD test methods for EDCs (e.g. it led the development and adoption of a test for endocrine-disrupting effects in fish and updates on test methods for screening of reproductive effects and for developmental toxicity), and worked within the OECD to prepare guidance for authorities and industry on the use of the test methods for EDC assessment (EPA[66]).

Figure 5.5. Denmark is an active player in evaluation of chemicals at the EU level



a) The list includes substances that have been evaluated or will be evaluated by 2021 (March 2019). Denmark also co-evaluated one additional substance.
b) The list includes the substances undergoing a PBT/vPvB assessment under the REACH Regulation or Biocidal Products Regulations. For REACH substances, inclusion in the list means that an informal hazard assessment for PBT/vPvB properties either is under development or has been completed since the start of the implementation of the SVHC Roadmap in February 2013 (March 2019).
Source: Dupont, Pelsy and Oulès (2016), *Service Contract for Technical Assistance to Review the Existing Member State Reporting Questionnaire under Article 117 REACH, Including the Evaluation and Configuration of an Appropriate IT Tool for the Reporting: Final Report;* ECHA (2019), ECHA, Information on chemicals (website), https://echa.europa.eu/information-on-chemicals.

StatLink http://dx.doi.org/10.1787/888934002509

Pesticides and biocides

The EU legislation on pesticides and biocides includes specific pre-marketing requirements and timelines. In principle, national authorities must authorise a product before it is placed on the market. There were about 650 authorised pesticides in Denmark in 2016 and some 350 authorised biocidal products in 2018 (Denmark, 2018[2]; ECHA[89]). Over 2008-17, Denmark evaluated 26 biocide active substances/product type combinations and 13 pesticide active substances (with co-responsibility for evaluation of further 14), with the final decision taken at the EU level. The validity of authorisation for an active substance in pesticides and biocides, and for a biocidal product, is typically no more than ten years. The validity of a pesticide product authorisation is linked to the active substance authorisation (ECHA, 2018[100]; Denmark, 2018[2]).

For pesticides, Denmark is responsible for hazard, exposure and risk assessment of products, based on information provided by the applicant. The EPA accepts the use of assessments performed in other countries, with limitations (e.g. adoption of Danish requirements on leaching to groundwater). Denmark collaborates on assessments with other countries in a so-called northern zone,[10] but the final decision is taken by national authorities (Northern zone, 2018[101]). For biocides, Danish authorities evaluate products under application for EU-wide authorisation and co-operate with other countries for product evaluation if an applicant seeks mutual recognition in multiple jurisdictions (ECHA, 2018[102]).

Testing requirements

For industrial chemicals, pesticides and biocides, the applicable EU legislation sets out testing requirements. The OECD Test Guidelines also apply. The EU legislation requires application of the OECD Principles of Good Laboratory Practice (GLP). Good Experimental Practice (GEP) applies for field trials on plant protection products. The Danish Accreditation Fund is responsible for GLP compliance and the EPA (with support from Aarhus University) for GEP compliance. For chemicals used offshore, the testing requirements follow the OSPAR Convention (Denmark, 2018[2]).

5.5.3. Contribution to identification of chemicals of concern

Denmark has long worked actively on identification of chemicals of concern. In recent years, the tendency has been to focus actions on supporting EU-wide activities.

As early as 1998, Denmark established a List of Undesirable Substances (LOUS). It was not legally binding, but guided the industry on what should be substituted. The latest version (2009) included 40 substances or groups of substances selected in line with EPA criteria (based on hazardous properties identified, for instance, by computer models). Over 2012-15, Denmark reviewed all the substances and groups of substances, in co-operation with stakeholders, with a budget of some EUR 6.4 million. The LOUS has not been updated, as its criteria largely overlap with those of the REACH SVHC.

Selection of substances for the LOUS allowed Danish authorities to create a 2009 list of effects, including 19 500 substances that fulfilled the LOUS criteria but whose use had not been assessed in Denmark (EPA, 2010[103]). The selection of chemicals for both lists was supported by the Danish work on (Q)SARs, prioritised in all Danish action plans on chemicals.

In line with national priorities, Denmark made significant efforts to identify potential EDCs and address combined effects of chemicals and nanomaterials (Box 5.8). Over 2013-15, the EPA carried out initiatives targeted at children, using the results as the basis for evaluation of total exposure of children (including those unborn) to more than 60 selected substances that were hormone disruptive, suspected of being hormone disruptive or posed neurotoxic and related risks (Larsen et al., 2017[104]).

Box 5.8. Top priorities for Denmark: Endocrine disruptors and nanomaterials

Denmark has assessed several potential EDCs and undertaken studies on the exposure of children to EDCs. It included potential EDCs on LOUS and ranked EDCs high on its environmental agenda during its 2010 presidency of the Nordic Council of Ministers and 2012 presidency of the Council of the European Union. In 2011, Denmark proposed EDC criteria for the REACH and plant protection product regulations and later pushed for their adoption. It also participated in the development of relevant OECD test methods and guidance documents. Denmark supported preparation of the 2018 UN Environment report on global EDC-related initiatives. Also in 2018, the government asked CEHOS to perform annual screenings of hazardous chemicals to support addressing EDCs at the EU level. In the context of EDCs, Denmark pushed for action to address phthalates at the national level (a holistic strategy adopted for 2013-15, a new set of compliance initiatives agreed in 2017) and the EU level.

On nanomaterials, Denmark has undertaken projects aiming at investigating, and generating new knowledge on, the presence of nanomaterials in products on the Danish market and assessing possible associated risk to consumers and the environment. About 30 reports are available.

Source: (Danish Chemicals Forum, 2015[105]; UN Environment/IPCP, 2017[106]; Denmark, 2018[2]; CEHOS, 2018[107]; Christensen et al., 2015[15]).

Regarding industrial chemicals, Denmark has actively supported identification of potential SVHCs at the EU level. It has been among the most active countries in this area, submitting ten dossiers between 2010 and 2018 (ECHA[89]). On pesticides and biocides, the EPA Pesticide Research Programme, in place since 1987, generates information that supports the regulatory measures for these chemicals. The National Allergy Research Centre, established in 2001, played an important role in providing documentation on human exposure to allergens, relevant for the EU-wide restrictions on the use of chromium in leather goods (2015) and the prohibition of methylisothiazolinone in leave-on cosmetics (2017). The Working Environment Research Fund, established in 2003, aims to strengthen research and development in occupational safety and health (Denmark, 2018[2]).

Pollution caused by pharmaceuticals is an emerging environmental problem. At the regional level, Denmark co-operates in the HELCOM collaboration platform on pharmaceuticals (EUSBSR, 2017[20]). Efforts at the national level have focused on pharmaceuticals in wastewater treatments plants, especially from hospital discharges (Denmark, 2018[2]).

Identification and evaluation of chemicals of concern were high on the agenda in Denmark during the review period. Multi-year action plans provided stability of funding. However, additional effort may be needed to sustain Denmark's standard-setting role in this area. The amount of work is rising (e.g. on analysing submitted data quality) and the transfer of fees from the EU level to support national activities started to diminish in 2016. The increasing amount of data (e.g. from research and implementation of legislation), combined with the increasing digitalisation of regulations and tools, will also require additional resources and capacity to better manage and use the information.

5.6. Risk management

Denmark applies a broad mix of instruments to risk management of chemicals. Regulatory, voluntary and other tools are adopted at the EU or national level. Denmark supports substitution of hazardous substances.

Danish environmental legislation incorporates the polluter-pays principle. The main legal instrument on chemicals, the Act on Chemicals, supplements this principle by making it possible for authorities to carry out chemical tests at industry's expense if the latter does not do it upon request. The Environmental Protection Act requires industry to take precautions to avoid or minimise pollution and, failing that, to address its consequences. Certain fees collected by national and EU authorities help finance relevant measures by Denmark (EPA, 2017[108]; MEF, 2017[109]).

5.6.1. Use of risk management approaches

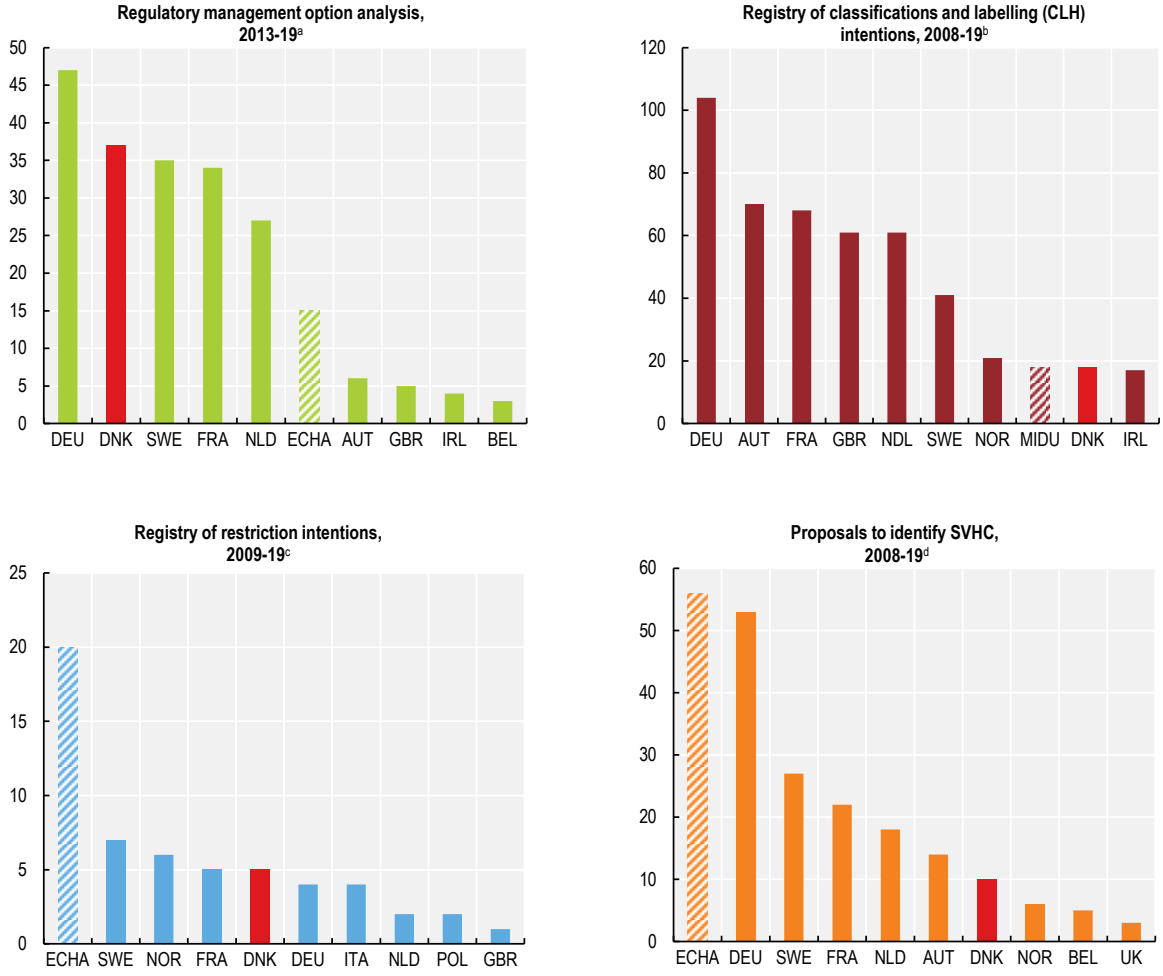
Regarding industrial chemicals, risk reduction provisions correspond to the authorisation and restriction stages of the REACH Regulation and harmonised classification and labelling under the CLP Regulation. Denmark has actively contributed to the relevant EU processes where possible (Figure 5.6), although initiative is reserved for the Commission in some areas. The timeline for application of risk management measures is usually enshrined in the applicable EU legislation. However, if a risk is of a national character, national measures can be applied, with no set timelines (Denmark, 2018[2]).

National regulations apply in areas not fully covered by EU or international legal frameworks. For instance, Denmark is one of the few countries with restrictions on the use of lead in gun ammunition (it applies a total ban, including outside wetlands) and fishing sinkers (ECHA, 2018[110]). The national restriction on importing or selling products containing lead is stricter than that of the EU (Fråne et al., 2018[111]).

For plant protection products and biocides, risk mitigation measures are identified during the authorisation process. Denmark applies additional measures in certain areas (e.g. voluntary agreements on pesticide use in public areas, thresholds for use on golf courses, training for professional users and distributors). For biocides, specific authorisation is required to use rodenticides with anticoagulants or to fumigate for pests. Danish rules on evaluation and approval of biocidal insecticides include provisions to protect bees and other non-target insects (Denmark, 2018[2]; MEF, 2017[8]).

Denmark has used taxes to reduce exposure to certain hazardous chemicals, but the PVC tax was recently abolished after a political agreement on easing the administrative burden on companies, and the phthalate tax was rescinded due to an agreement on an EU-wide restriction (Denmark, 2018[2]).

Figure 5.6. Denmark actively contributes to risk management of chemicals at the EU level



a) The regulatory management option analysis (RMOA) list includes substances for which an RMOA is either under development or has been completed since the start of the implementation of the SVHC Roadmap in February 2013.
b) CLH - Harmonised classification and labelling; MIDU - manufacturers, importers or downstream users.
c) Includes co-submissions.
d) Denmark is a co-submitter for one entry. Countries or ECHA may prepare Annex XV dossiers for the identification of substances of very high concern (SVHC).
Source: ECHA (2019), *ECHA, Information on chemicals* (website), https://echa.europa.eu/information-on-chemicals.

StatLink http://dx.doi.org/10.1787/888934002528

The area of occupational work and safety features national legislation and guidelines, combined with monitoring, research and stakeholder collaboration on safe work. It includes considerable flexibility in adopting national risk management measures related to CMR substances. In the last ten years, Denmark has adopted occupational guidelines for 17 substances, most of which had to be implemented within three to five years (Denmark, 2018[2]).

The unintentional poisoning mortality rate dropped between 2006 and 2016 from 5.4 to 3.8 per 100 000 people (SD, 2018[112]). Poison centres support safe use of chemicals, as well as preventive and curative measures, by providing medical advice to the public and doctors on emergencies related to exposure to chemicals. The information is provided to both the EPA and, for mixtures in professional use, the WEA (ECHA[113])

Labelling programmes in Denmark include official ones (e.g. the EU eco-label and Nordic Swan) and private ones (e.g. the Blue Wreath and Allergy Certified). All support risk reduction by limiting the use of hazardous chemicals and promoting substitution by less hazardous alternatives.

5.6.2. Promoting substitution of hazardous chemicals

Substitution of hazardous chemicals is enshrined in EU and Danish legislation and policy documents and in international agreements such as the OSPAR Convention (Denmark, 2018[2]). Danish OHS rules require replacing hazardous substances with less hazardous ones, even if the effects of the former are insignificant (Camboni, 2017[114]).

The LOUS has long supported substitution by informing industry about substances whose use should be reduced or terminated. The 2014-17 Chemical Initiatives included a partnership between industry and academia to support substitution of certain chemicals of concern (Danish Chemicals Forum, 2015[105]; Denmark, 2018[2]; Kemi i Kredsløb, 2018[115]). A new innovation centre on substitution of hazardous chemicals follows up on that initiative under the 2018-21 Chemical Initiatives. An eco-innovation subsidy programme, under the 2015-18 MEF Environmental Technology Development and Demonstration Programme, supported research on substitution (MEF[116]). The Pesticide Research Program supports reduction of pesticide use (including biocides) and research on their negative effects on human health and the environment. Since 2016, the Chemical Initiatives have supported substitution with less harmful biocides (e.g. by subsidising their authorisation under a simplified procedure) (Denmark, 2018[2]). The Centre for Catalysis and Sustainable Chemistry at Technical University of Denmark is working on chemistry innovation and on improvement to known processes in areas such as renewable chemicals and sustainable production of chemicals (Centre for Catalysis and Sustainable Chemistry, 2017[117]).

Recommendations on chemicals management

Develop innovative tools to help decision making

- Further expand risk-based monitoring of chemicals. For instance, enhance monitoring of legacy pesticides and their metabolites in groundwater and approved pesticides under the Pesticide Leaching Assessment Programme, and consider supplementing it with surface-water monitoring (relevant for biocides). Consider enhanced monitoring of emerging pollutants (e.g. pharmaceuticals in surface water and groundwater) and heavy metals (e.g. zinc in soil and water).
- Strengthen biomonitoring to provide better evidence of people's actual exposure to endocrine-disrupting chemicals and possible effects on human health to support policy making in this area; address trade-offs between monitoring and proactive identification of chemicals requiring regulatory action, taking into account the science-policy nexus (e.g. identification of exposure source).
- Make assessment of the Chemical Initiatives' effects a standard procedure and consider further development such as increasing the use of indicators to track implementation progress.
- Make better use of PRTR data (e.g. for tracking trends in releases or benchmarking among companies).

Implement and influence EU legislation

- Continue identifying national priority areas for strengthened chemicals management and performing an active role at the EU level in identifying chemicals of concern (including the need for substitutes) and assessment of chemicals, including predictive risk assessment (e.g. in relation to endocrine-disrupting chemicals and quantitative structure-activity relationships) and risk management.
- Assess implications of the coming reduction in REACH registration fees on activities that the fees are intended to support in Denmark.
- Strengthen efforts at the national and international levels on compliance assurance for high-risk chemicals in products (including imports and e-commerce), for instance through enhanced co-operation with customs.
- Assess the effectiveness of new measures to strengthen emergency response for the most hazardous facilities (covered by the EU Seveso III Directive).

Notes

[1] Carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.

[2] Acidifying gases: sulphur dioxide, nitrogen oxides, ammonia. Air pollutants: non-methane volatile organic compounds, carbon monoxide, polycyclic aromatic hydrocarbons, particulate matter. Heavy metals: lead, cadmium, mercury.

[3] The German Environmental Survey for Children and the US National Health and Nutrition Examination Survey.

[4] www.virk.dk. In certain cases the data is collected by the EPA and added to the national PRTR, e.g. on emissions from farms (from the Central Husbandry Register or Fertiliser and Livestock Reporting Body), from wastewater treatment plants (from NOVANA) and from aquaculture (from the aquaculture database). The EPA conducts a manual review of the data (MEF, 2016[28]).

[5] Later extended to 2016.

[6] The inspection programme addresses the establishment's production and risk conditions, the surrounding area and factors relevant for individual establishments (Amec Foster Wheeler, 2017[55]).

[7] For each effect chain, inputs, activities, outputs and effects are listed. The effect chains were prepared by the EPA, validated by external experts and submitted to industry consultation. The resulting knowledge led to qualitative and, where possible, quantitative analyses of effects (Sørensen et al., 2017[63]).

[8] The Convention for the Protection of the Marine Environment of the North-East Atlantic. The parties are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom (OSPAR Commission[118]).

[9] The Convention on the Protection of the Marine Environment of the Baltic Sea Area. The parties are Denmark, Estonia, the European Union, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden (HELCOM[119]).

[10] The zone covers Denmark, Estonia, Finland, Latvia, Lithuania, Norway and Sweden (European Parliament and Council of the EU, 2012[120]).

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